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FACTORY

MANAGEMENT and MAINTENANCE

A McGRAW-HILL PUBLICATION

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CLOSED-SHOP DRIVE STALLS AT ALLIS-CHALMERS

You who are responsible for production and maintenance have a new ally in your fight against corrosion —Synthane Bakelite-laminated.

The use of Synthane is recommended for parts in contact with many acids, alkalies, salts, oxidizing agents, gases, solvents and water. Successful applications have been made in equipment exposed to electro plating solutions, electrolytic, rayon and cellophane process solutions, paints and mine waters. Synthane has been in use for ten years but not until recently has its resistance to corrosive conditions been fully tried and proved.

If you are interested in prolonging the life and improving the performance of parts of your equipment subject to corrosion, take advantage of the facilities of our laboratory and plant. Our laboratory is well equipped to investigate your application. We manufacture Synthane Bakelite-laminated in sheets, rods, tubes and special shapes and can machine Synthane Bakelite-laminated in *any* way to your specifications. Get in touch with our representatives—in all principal cities or write directly to us for information on your application.

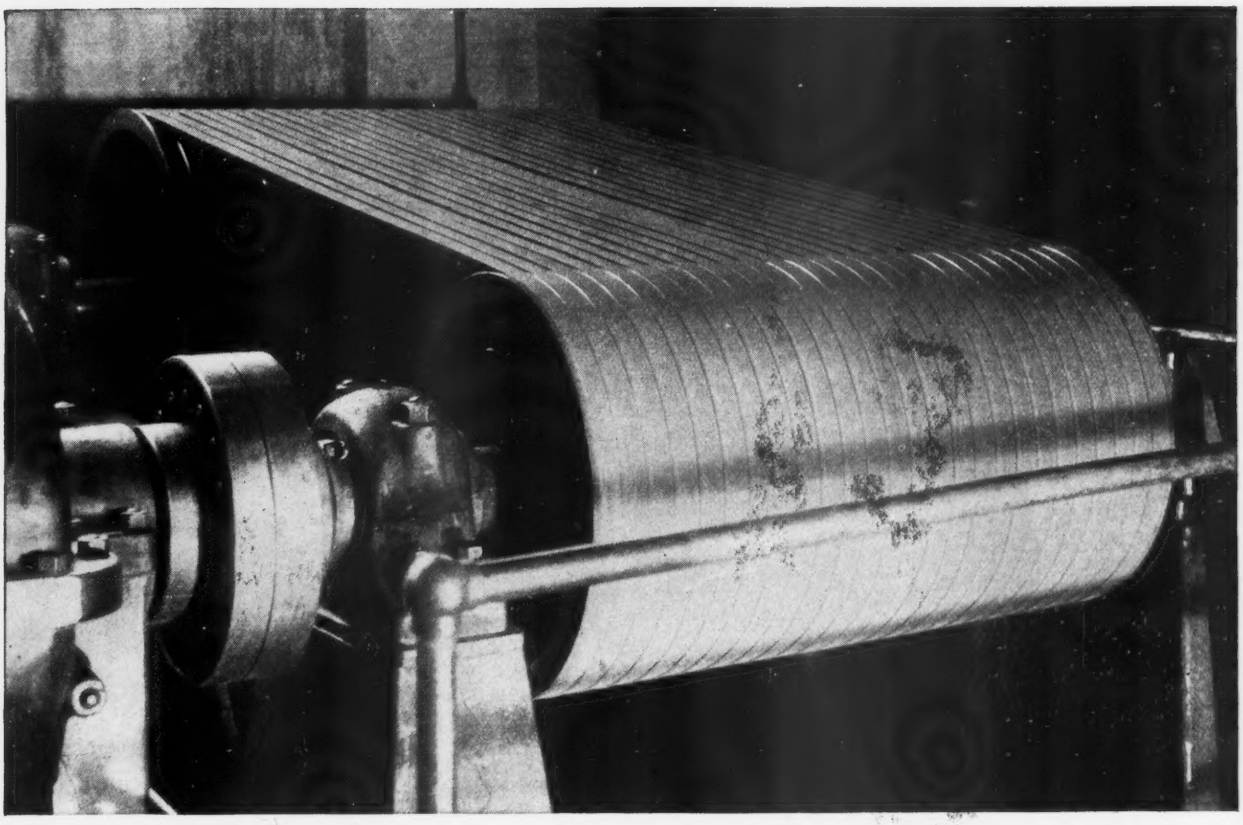
NOTE: Corrosion resistance is only *one* of many *combined* properties of Synthane. Just as an example, others which may be important to you are: light weight, strength, ease of machining and excellent electrical insulating characteristics.

SHEETS • RODS • TUBES • FABRICATED PARTS • SILENT STABILIZED GEAR MATERIAL

SYNTHANE CORPORATION, OAKS, PENNSYLVANIA

SYNTHANE
Bakelite— laminated

To Put off MAINTENANCE TROUBLES . . . . *Put in* SYNTHANE



Goodrich tension-matched V-Belts

last 14 times longer on belt-killing turbine drive

BELT cost was high on the big steam turbine drive shown above. Ordinary V-Belts could not pull the load; and failed in less than a month.

Then Goodrich V-Belts were tried — matched under operating tension so that each belt carries its full share of the load, and slippage and resultant wear are prevented. After 14 months these Goodrich Belts are still running and they look as sturdy as the day they were installed.

Next time you buy V-Belts remember this new additional value — sets matched under operating tension. Belts which measure the same off the drive often — in fact usually — develop differences in length once they start operating. The longer belts then slip, wear out, put undue load on the others. You can avoid this costly failure by specifying Goodrich matched sets — V-Belts measured under operating conditions.

Goodrich machine which measures Goodrich V-Belts under actual operating tension.

More Goodrich Construction Improvements

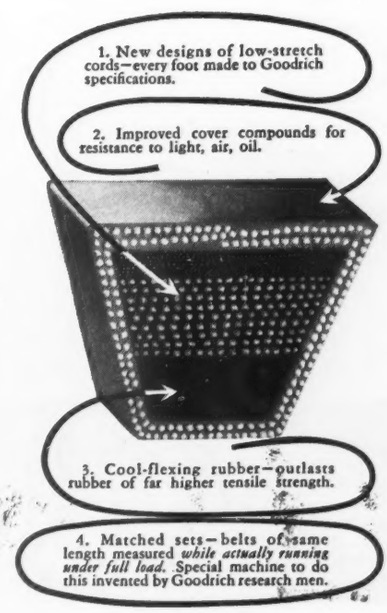
There are other Goodrich V-Belt advantages that will save you money, reduce time and work now taken by shutdowns for belt repair and replacement. Some of these are a rubber-and-fabric cover to protect the belt from dust and moisture; low-stretch cords which reduce stretch and slippage; Age-Rite, a compound to help Goodrich belts resist oxidation; and a special rubber compound which reduces internal heat by 75%.

V-Belts should and can be an efficient, trouble-free, economical means of transmitting power. Call in your Goodrich Distributor and let him show you the improvements in Goodrich V-Belts which make these belts last so much longer than belts of even a few years ago. The B. F. Goodrich Company, Mechanical Rubber Goods Division, Akron, Ohio.

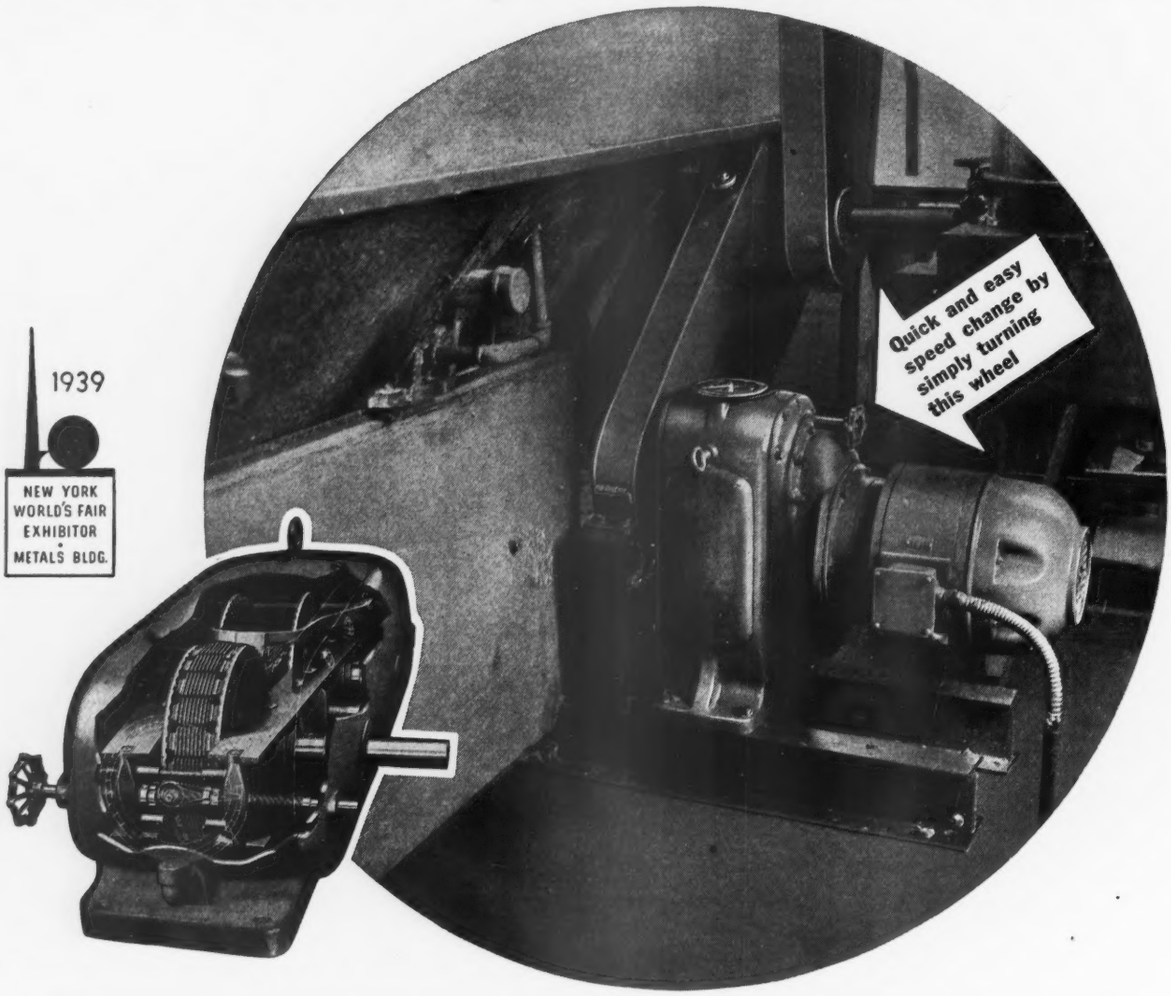
Goodrich

ALL *products problems* IN RUBBER

Recent Improvements in Goodrich V-Belt


1. New designs of low-stretch cords—every foot made to Goodrich specifications.
2. Improved cover compounds for resistance to light, air, oil.
3. Cool-flexing rubber—outlasts rubber of far higher tensile strength.
4. Matched sets—belts of same length measured *while actually running under full load.* Special machine to do this invented by Goodrich research men.

HOW ACCURATE SPEED CONTROL TAKES THE GUESS WORK OUT OF A DELICATE OPERATION



● When the singeing machine in the Cold Springs Bleachery, Yardley, Pa., was driven by a steam engine with variable speed governor, accurate speed control, so essential in this process, was difficult to obtain. This deficiency was remedied by the installation of the Link-Belt P. I. V. Gear speed variator and silent chain drive shown here.

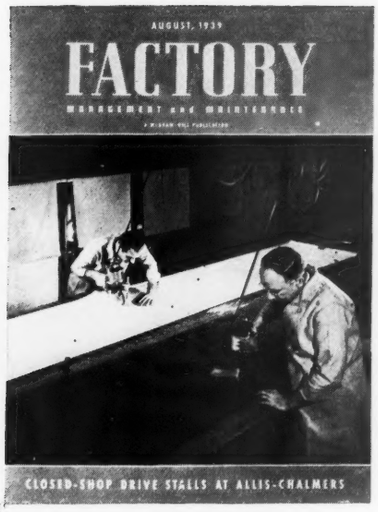
In the P. I. V. Gear, positive engagement of a unique chain with grooved steel wheels completely eliminates any possibility of slippage or irregularity in speed. By an easy turn of a small hand wheel the speed can be regulated while the machine is running. There are no "steps,"—a change of a minute-fraction of a revolution is available at the turn of the wrist.

On countless machines and in every type of industry, P. I. V. Gear units are improving quality, eliminating waste, promoting uniformity and cutting costs by reducing product spoilage. Built for vertical or horizontal mounting, motorized, and with extra built-in reductions, they meet every conceivable operating requirement. Complete details are contained in Book No. 1574. Send for it.

LINK-BELT P.I.V. GEAR SPEED VARIATOR

Link-Belt Company, Philadelphia, Indianapolis, Chicago, San Francisco, Atlanta, Toronto. Offices in all Principal Cities. 7773

LINK-BELT POSITIVE DRIVES INCLUDE



THIS MONTH'S FOUR-COLOR COVER illustration shows machine cutting of cushion covers for porch gliders. The Kodachrome was taken by William Rittase in the plant of the J. R. Bunting Company, at Philadelphia. Top strips of the piles of colorful water-resistant material are marked according to templet. Then the circular, motor-driven, high-speed cutters, guided by the skilled hands of the operators, walk right through the piles. When a cutter gets dull an abrasive stone, mounted on the machine housing, is moved down to do its sharpening job as the cutter revolves.

•

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FACTORY

MANAGEMENT and MAINTENANCE

AUGUST, 1939

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Finnell Dry Scrubber SAVES PLANT $475 ANNUALLY!

Reprinted from . . .
500 QUICK WAYS TO PROFITS
— Factory Management and Maintenance, November, 1938.

Floor Cleaner Pays Out in Year

Concrete floors in the machine shop of a metalworking plant soon become coated with a hard crust composed of dirt, metal chips, and oil. Formerly it was the practice to have a crew of three men equipped with scrapers and brushes go over the machine shop several times a year. About four days were required for each cleaning. The annual cost amounted to about $575

After a double-brush floor cleaning machine fitted with scarifying brushes had been put into service, it was found that the machine shop floor can be gone over by two men in one day. With the same number of cleanings per year as formerly, the annual cost is somewhat less than $100, representing a saving of about $475.

At this rate the floor machine paid for itself in considerably less than a year.

See what it will save you

Demonstration — on your own floors — involves no obligation. Phone nearest Finnell branch, or write Finnell System, Inc., 2508 East Street, Elkhart, Indiana.

FINNELL SYSTEM, INC.

Pioneers in FLOOR-MAINTENANCE EQUIPMENT

ASK YOURSELF THIS QUESTION:

Are you getting these EXTRA values when you buy electrical products?

WOULDN'T you like to get definite *extra values* with every dollar you spend on electrical equipment? You do just that when you deal with Graybar.

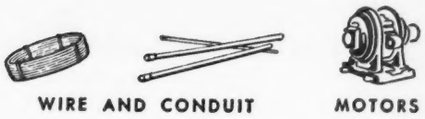
For instance, you get a solid Graybar guarantee backing up every sale, every item.

You get helpful cooperation from Graybar men experienced for years in meeting just such factory electrical requirements as yours.

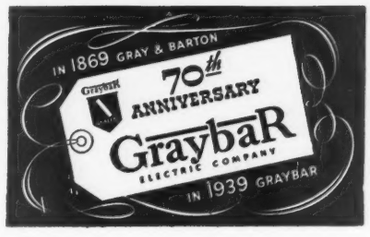
You get the benefit of a nearby, well-stocked Graybar warehouse. You can use it as your *own* stockroom and save the cost of maintaining large reserve electrical supplies.

You get prompt "action service" to save you time when time means money. Including speedy truck delivery that rushes you what you want *when* you want it.

Graybar gives you full value in every product *plus* extra values that go beyond the product. Investigate! Call on Graybar for your next electrical need!



WIRE AND CONDUIT MOTORS



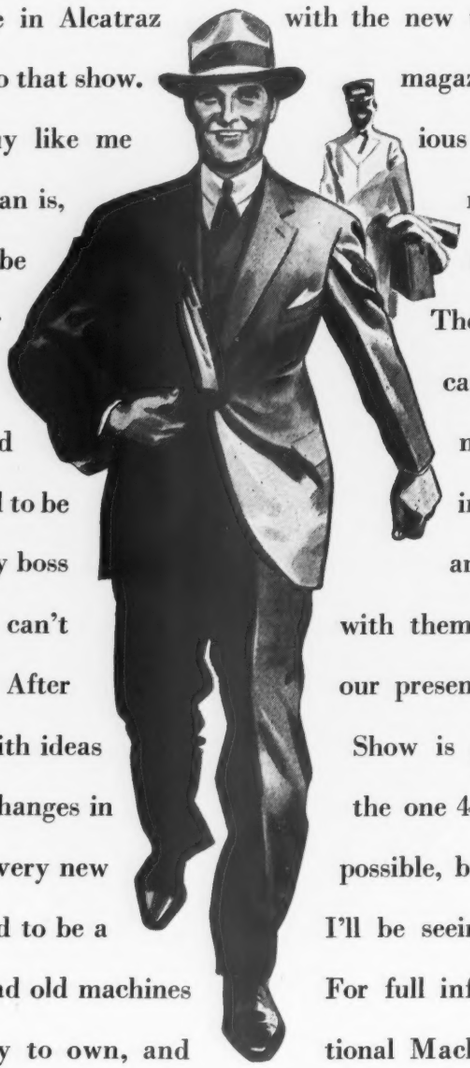
LIGHTING WIRING DEVICES SIGNALS

OFFICES IN 83 PRINCIPAL CITIES

EXECUTIVE OFF., GRAYBAR BLDG., N. Y.

You couldn't keep me away from it!

"AM I going to the Machine Tool Show? Why, listen, if they had me in Alcatraz I'd get away somehow to go to that show. That's something that a guy like me simply has to do. What I mean is, among production men there'll be just two kinds of people after October 13—those who went to the Machine Tool Show and those who didn't. I can't afford to be one of the second kind. And my boss is smart enough to know he can't afford to have me miss it. After the 1935 Show I came back with ideas that resulted in a number of changes in equipment. And believe me, every new machine tool we bought proved to be a wonderful investment. We had old machines that were costing us money to own, and the Machine Tool Show gave us just the information we needed to have. I try to keep up with the new things as they come out in the magazines and literature from the various machine tool builders, but there's nothing like seeing the machine itself and watching it operate. There at the Show in Cleveland I can see them all — every kind of machine tool with the very latest improvements — under one roof; and all the newest gadgets to go with them—a lot of them adaptable to our present equipment. I hear this year's Show is going to be even better than the one 4 years ago! That sounds hardly possible, but I'm not taking any chances. I'll be seeing you in Cleveland. . . . . ." For full information, please address National Machine Tool Builders' Association, 10525 Carnegie Avenue, Cleveland, Ohio.

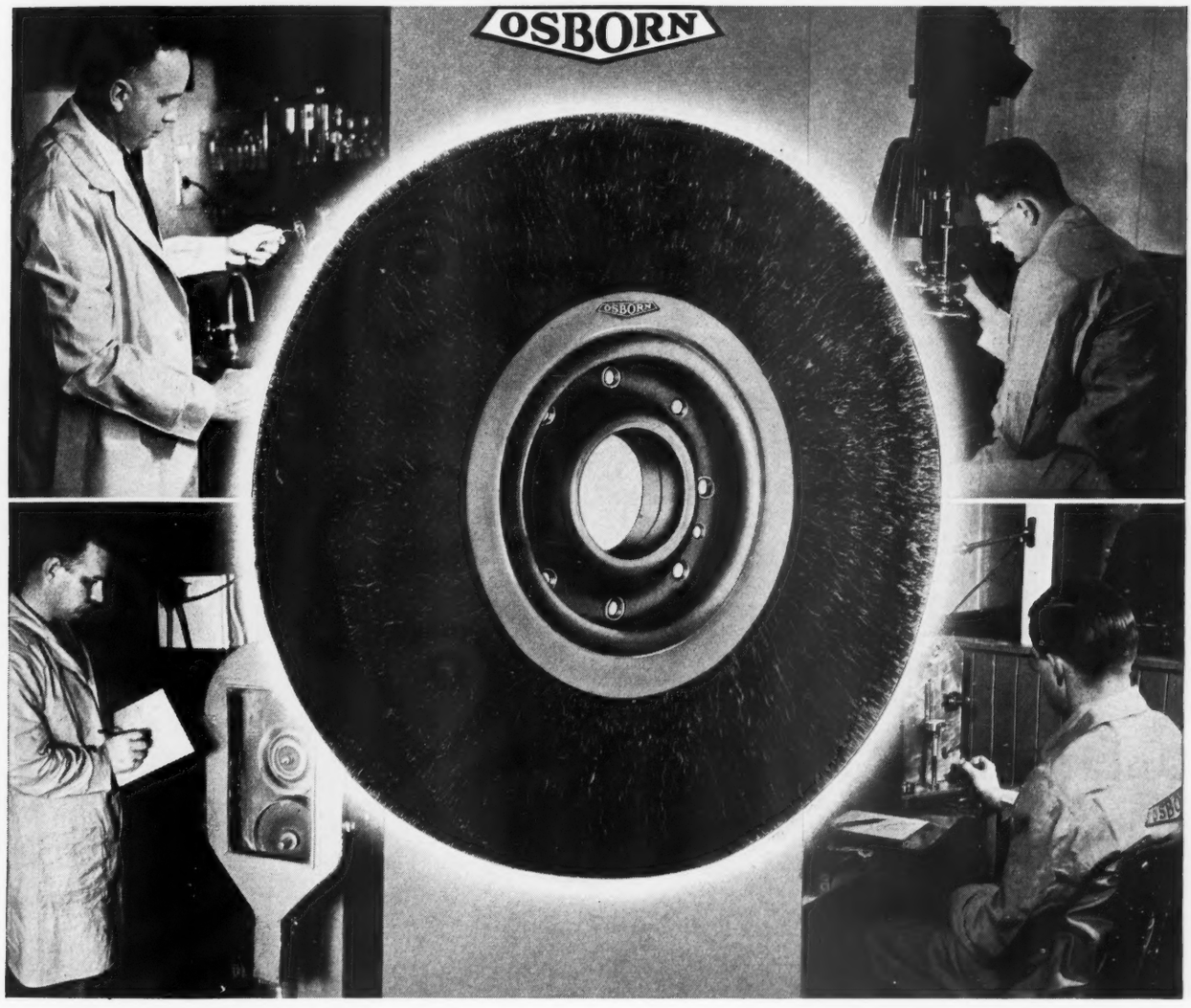


MACHINE TOOL SHOW OF 1939

CLEVELAND • OCTOBER 4TH TO 13TH

YOUR SMARTEST INVESTMENT TODAY . . . MODERN MACHINE TOOLS

OSBORN BRUSHES ARE THE RESULTS OF RESEARCH



for example : THE OSBORN MASTER WHEEL

RESEARCH MAKES Osborn Brushes BETTER BRUSHES

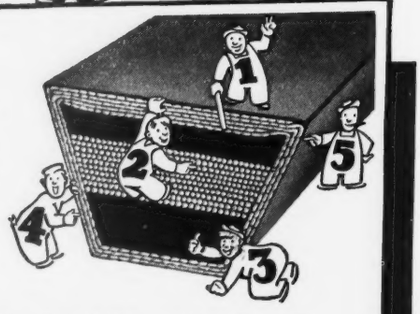
● RESEARCH made the Osborn Master Wheel what it is today: a fine tool, correctly balanced, true-running, fast-working . . . the ideal, general purpose wire wheel brush. ● Osborn Research has achieved a multitude of other developments with production and maintenance brushes through constant study of brush requirements in all industries. ● Have YOU investigated all possible uses of brushes in YOUR plant? Brushes do many jobs faster, better and at lower costs than are obtainable with other methods or equipment. ● Look to Osborn and your Osborn Distributor for the high standard of brush service Osborn has made available for your use. *Ask about it!*

THE OSBORN MANUFACTURING COMPANY • 5401 HAMILTON AVENUE • CLEVELAND, OHIO

Gilmer BELTS

ORDER GILMER BELTS
FROM YOUR DISTRIBUTOR

Only Gilmer "Precision-Plus" V's give you these 5 Famous Features



Gilmer Top Tension Rubber—Tough, resilient. Cuts out costly misfits.

Gilmer Rubber-locked Pulling Cords—Patented construction, concentrating brute strength in thin section, makes cords ride parallel, without twisting, under pressure.

Gilmer Heat-resisting Bottom Rubber—Specially developed by Gilmer to insure cool running at high speeds and eliminate "squashing" in the groove.

Gilmer Heavy Jackets — Protect the belt's vital working parts from oil, dirt, and grease, making Gilmers last three times as long.

Gilmer Controlled Stretch — Pre-tested, to guarantee permanently matched working lengths on every job.

L. H. GILMER COMPANY
Tacony, Philadelphia
The Oldest Firm of Rubber
Fabric Belt Specialists

31% LESS STANOCYL USED IN 8 MONTHS TEST
● HERE ARE THE FACTS. It all started when oil carryover to the boilers in a Kansas municipal water works became troublesome. The only remedy was to cut oil feeds to the minimum. The Chief Engineer at the plant agreed to compare the consumption of StanoCyl with the oil then in use and buy the oil that gave lowest consumption.
Here's what the record shows for oil consumption on the engines driving one 8 and one 15 m.g.d. water pump:
DAYS RUN GALLONS USED GALLONS PER DAY
Oil A 251 324 1.29
StanoCyl "D" .. 242 216 .89
Even with this reduced consumption StanoCyl gave better lubrication and oil carryover was negligible.
Why not make this test in your own engines? Others have saved as high as 50% of their oil costs by changing to StanoCyl. A Standard Lubrication Engineer will gladly specify the right grade of oil to use and help you make this test. Call him today at your local Standard Oil (Indiana) office or write 910 South Michigan Avenue, Chicago, Illinois.
Copr. 1939, Standard Oil Co. (Ind.)
STANOCYL
STEAM CYLINDER OIL
FIRST IN SERVICE
FOR FIFTY YEARS
STANDARD OIL (IND.)
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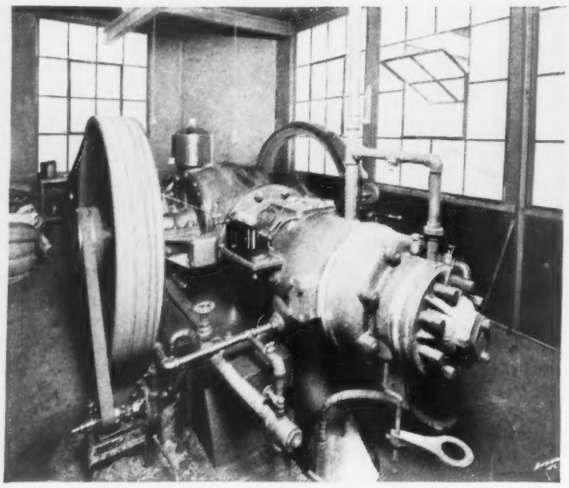
...LUBRICATION ENGINEERING...LUBRICATION ENGINEERING...LUBRICATION ENGINEERING...LUBRICA

G . . . LUBRICATION ENGINEERING . . . LUBRICATION ENGINEERING . . . LUBRICATION ENGINEE

MORE SOLUTIONS TO LUBRICATION PROBLEMS

NONPAREIL DIESEL OIL

Carbon formed so rapidly in this 80 HP Diesel that the engine delivered its full power only for short periods immediately after frequent cleanings. After nursing the engine along for a number of years the plant engineer decided to do something about it. He called in a Standard Lubrication Engineer and asked for his suggestions.



The Lubrication Engineer checked the engine to determine the right grade of oil to use, and recommended Nonpareil Diesel Oil Heavy. That was all. Now, with Nonpareil, this engine runs four times longer without cleaning and in addition it uses 36% *less oil*. That's one reason for the clean operation of Nonpareil. It takes so little oil for adequate lubrication. And that's another reason for the low cost Diesel operation reported by Nonpareil users.

TO HELP YOU JUDGE LUBRICATING OIL QUALITY

• WHETHER you buy lubricating oil or are responsible for the equipment on which it is used, the booklet "Spare the Time to Spare Your Machines" will give you helpful suggestions for determining desirable qualities in an oil.

It describes terms like "Demulsibility," "Stability," and "Viscosity Index," and explains their importance in determining the right type of oil for various services—a convenient source of facts about oil which you can use to advantage.

STANDARD OIL COMPANY (Indiana) AUGUST
910 S. Michigan Avenue, Chicago, Illinois, Room 1217

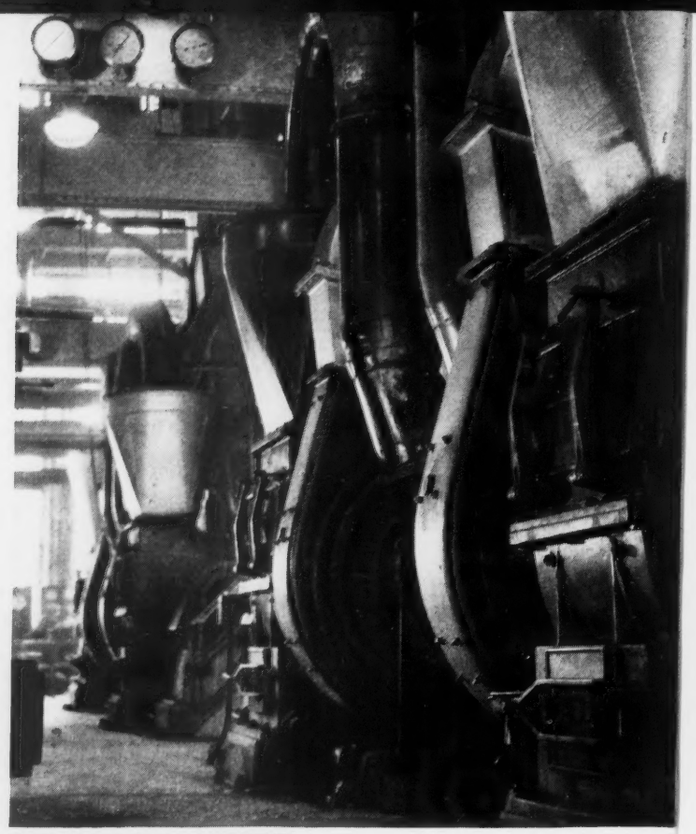
Gentlemen: Please send me the booklet "Spare the Time to Spare Your Machines."

Name.....

Company.....

Address.....

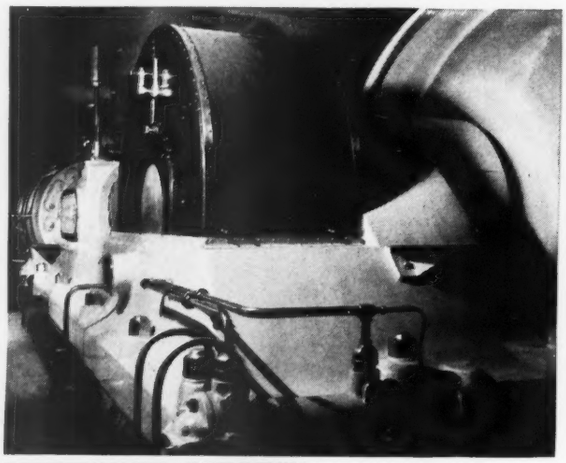
City..... *State*.....



SUPERLA GREASE

Grease leakage and contamination from coal dust was causing the bearings in 20 Raymond Mills to stick. This naturally increased power demands, overloaded the motors and made burned bearings a continuous hazard. The plant engineer was convinced that he would have to find a better lubricant. That gave a Standard Lubrication Engineer his chance. He recommended Superla Grease No. 4X.

It has been almost 5 years since these bearings started on Superla. Dust-trouble and sticking bearings have been entirely eliminated, but best of all, consumption has been reduced from 2,000 lbs. of grease per month to 600 lbs. for all 20 units.

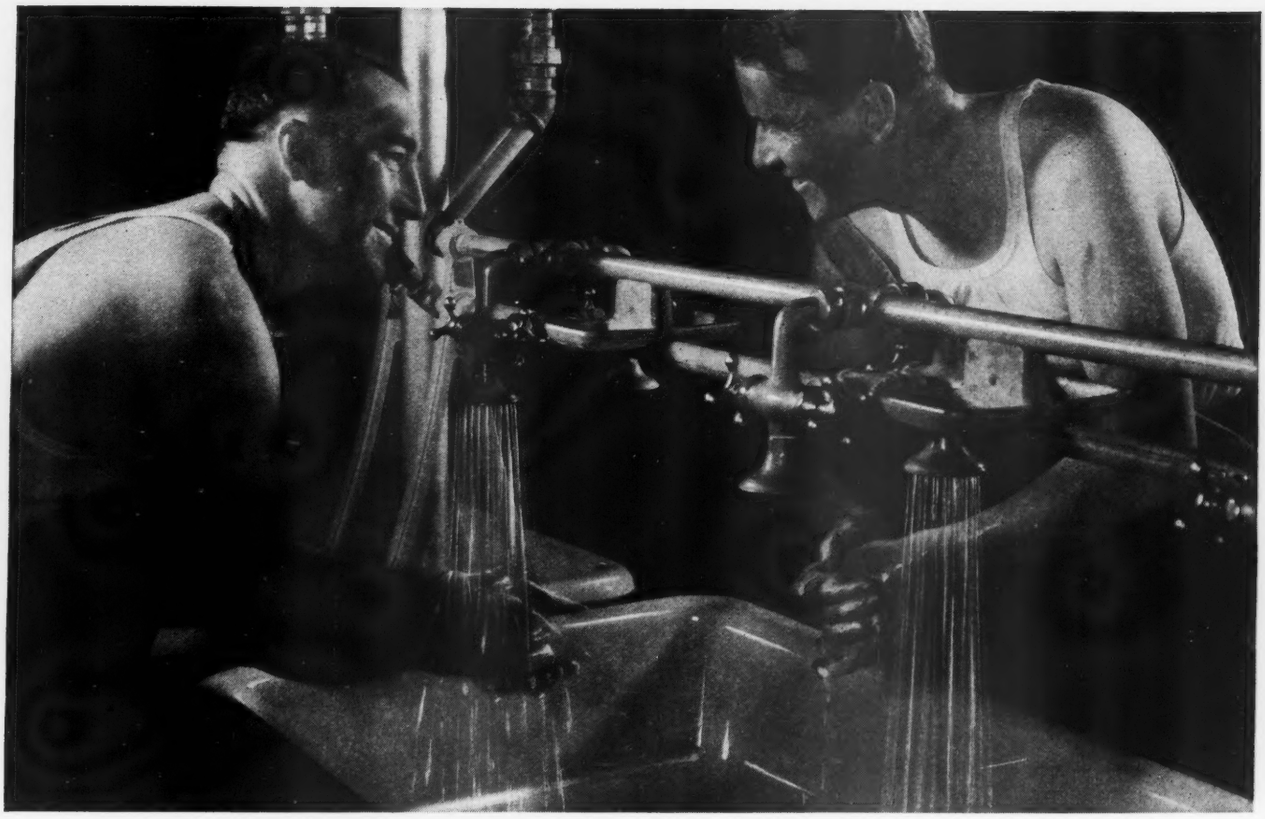


STANOIL

When Stanoil solved an oil vaporization problem in the crank case of a Skinner Uniflow engine it also saved the cost of many paint jobs and as much as 10% in oil consumption.

The oil formerly used in an Indiana manufacturer's power plant vaporized badly. This not only caused high consumption, but the oil vapor collected on the engine room ceiling and made frequent cleaning and repainting necessary.

A number of other oils were tried. Only Stanoil No. 50 had the required viscosity without the light volatile ends that would vaporize.



Crane has a complete line of showers for industrial use, with special features that assure not only a more refreshing stream, but water economy and durability as well. Illustrated is No. C-4742-G.

Trim and good looking, yet designed in every detail for industrial use, is this Crane No. C-11495 Speedway Closet. It is designed for easy cleaning—has a positive, vigorous flush—is economical of water.

Satisfied at wash-up time

. . . Ready for good work tomorrow

You can do a lot to encourage employees to smile at wash-up time by providing the right kind of sanitary facilities. Making their washing-up more convenient and enjoyable will go a long way in promoting better employee relations—a satisfaction that is reflected in improved efficiency.

Crane Co. has published a brochure on the subject of "Plumbing for Industrial and Commercial Buildings." It offers important aid in solving factory sanitation problems . . . gives help in choosing proper equipment. It explains the dangers to health of back-siphonage in plumbing installations, tells how to avoid them. Read this book to understand fully the many vital requirements of modern sanitation, and to know the advantages you gain by having plumbing installed by qualified licensed master plumbers only.

Crane Industrial Plumbing equipment includes conveniences that employees appreciate—as well as features that mean added value from the management's viewpoint. It is built to stand more than ordinary usage—with the sturdiness that industrial use demands. Why Crane Plumbing is a better investment for plants both large and small, is told convincingly in "Crane Plumbing for Industrial and Commercial Buildings." Mail the coupon for your free copy.

CRANE

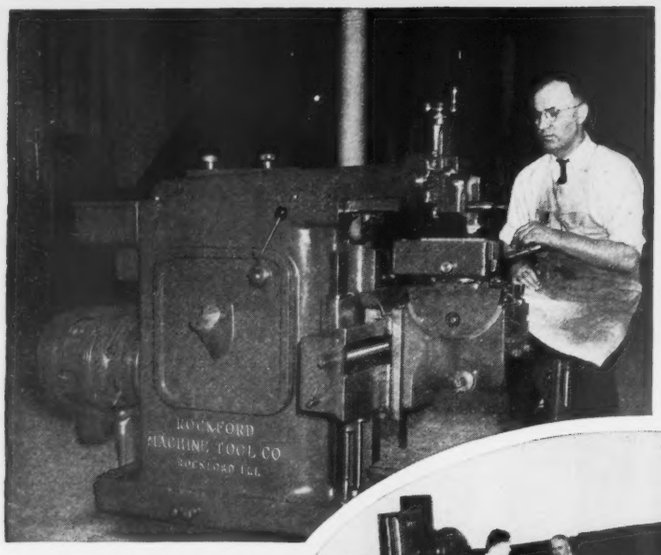
CRANE CO., GENERAL OFFICES: 836 SO. MICHIGAN AVE., CHICAGO

VALVES • FITTINGS • PIPE • PLUMBING • HEATING • PUMPS

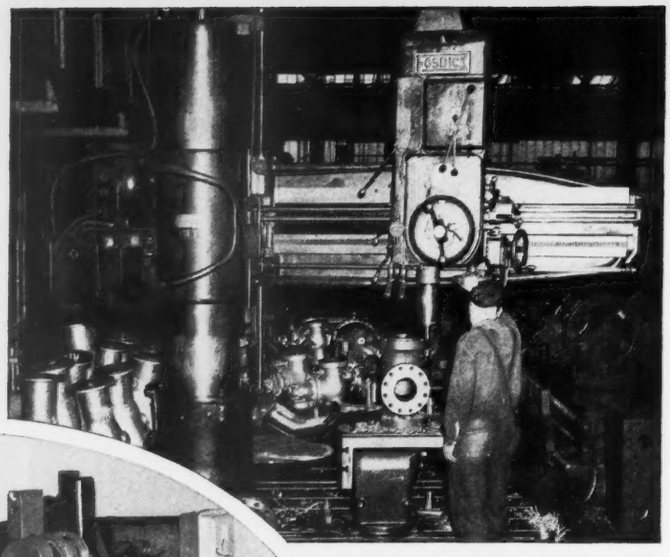
CRANE CO. FM&M-8-39
836 South Michigan Ave., Chicago, Illinois
Gentlemen: I want a copy of "Crane Plumbing for Industrial and Commercial Buildings"—without obligation, of course.
Name.....
Street.....
City.....*State*.....

NATION-WIDE SERVICE THROUGH BRANCHES, WHOLESALERS, PLUMBING AND HEATING CONTRACTORS

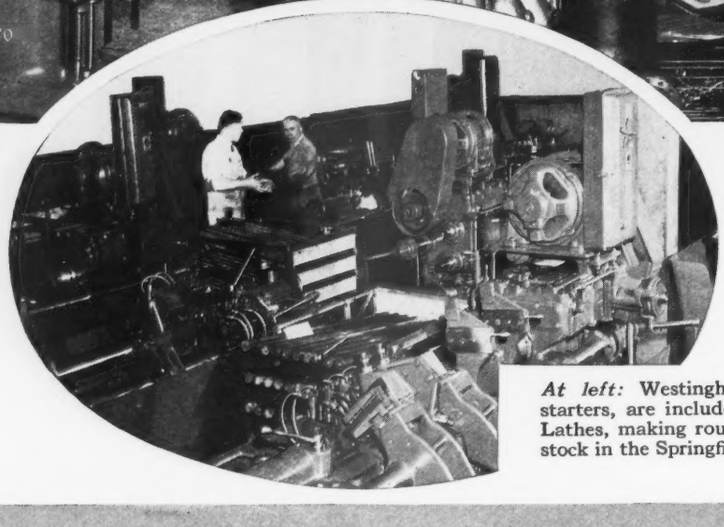
THEY'RE IN THE ARMY
doing machine jobs the



Above: This 12" Rockford Hydraulic Shaper in the tool room of the Springfield Armory is amply powered for heavy cuts, with a Westinghouse flange-mounted gearmotor. Equipped with Westinghouse control.



Above: Fosdick Economax 8' Radial Drill, one of two such machines in the Brooklyn Navy Yard shop, equipped with Westinghouse motors and control. This powerful machine can be depended upon to handle tough drilling jobs easily, with the ample capacity in the motor to take care of the load.



At left: Westinghouse motors and "De-ion" Linestarters, are included on the ten 12" Fay Automatic Lathes, making rough and finished cuts on rifle barrel stock in the Springfield Armory.

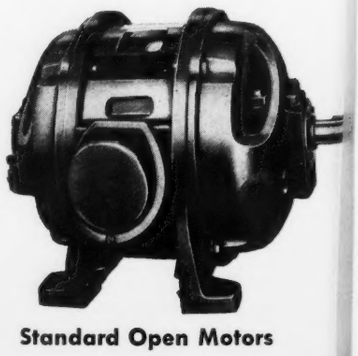
WESTINGHOUSE EQUIPMENT "STANDS UP AND TAKES IT"

Toughness and durability are built into every part of Westinghouse motor and control equipment. You'll save money in the long run by specifying Westinghouse drives for every industrial use. And . . . the diversity of the Westinghouse line allows you to select the right drive for the job to be done.

Combination Linestarters

◄ One packaged unit does 4 jobs
Westinghouse Combination Linestarters cost less to install, and combine four jobs in one unit: magnetic motor starter, manual disconnect switch, motor overload protection and Nofuze circuit protection. Save wiring, conduit, labor, get better results, with Westinghouse Combination Linestarters.

Extra features at no extra cost ►
Westinghouse standard AC motors provide the extra mechanical strength of rigid one-piece frames, and the extra electrical strength of Tuffernell insulation. Bearings, either ball or sleeve, free from lubrication grief.



Standard Open Motors

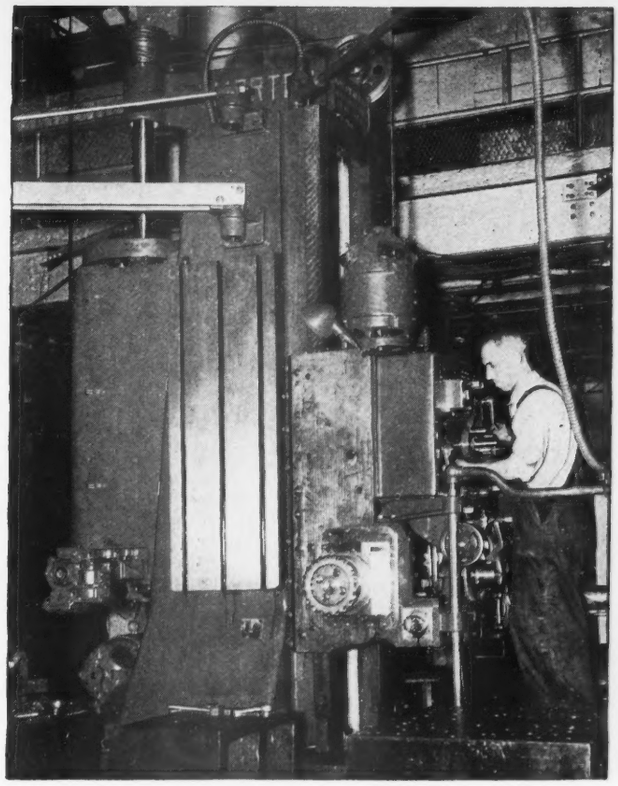
Westinghouse

W
WESTINGHOUSE ELECTRIC

AND NAVY *NOW*....
modern electrical way

Modernizing with Westinghouse motors and control helps armories, navy yards and mobilized industry maintain high production schedules, reduce outage time, and save money and maintenance.

Whether you are concerned with national defense programs, or engaged in industrial manufacturing, you are interested in cutting costs and improving production. Your local Westinghouse representative will help you do it electrically. Call him. Or, if you prefer, write Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. Address Dept. 7-N.



Above: Ample power and convenient operation assured at all times on this new 60" Morton Traveling Head Draw Shaper in the Brooklyn Navy Yard — it is equipped with Westinghouse motor and control.

J-90215

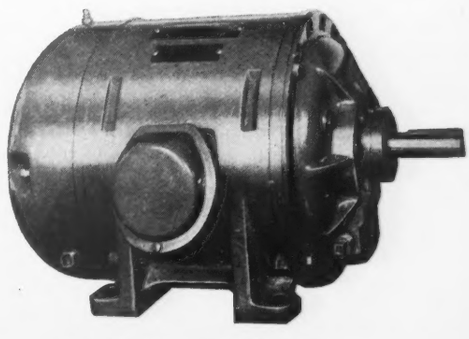
Safety Switches

◀ **Extras that cut operating costs:** Westinghouse Safety Switches give you more for your money — in better protection. Diamond pointed jaw and extended blade keep contact areas clean, free from beading. One-piece copper parts make fewer connecting points.

High speed motor efficiency for low speed machines: ▶ You get the exact horsepower needed at the required rpm of the driven machine, all in one space-saving motor. Simplifies installation, eliminates maintenance of belts, pulleys, sprockets and chains. Delivers 96% to 98% of the motor's efficiency.

Protection for motors wherever the chips fly: ▶ Electrical parts in Westinghouse totally enclosed, fan-cooled motors are sealed from outside air, dust, dirt, grindings or other particles that ruin ordinary motors.

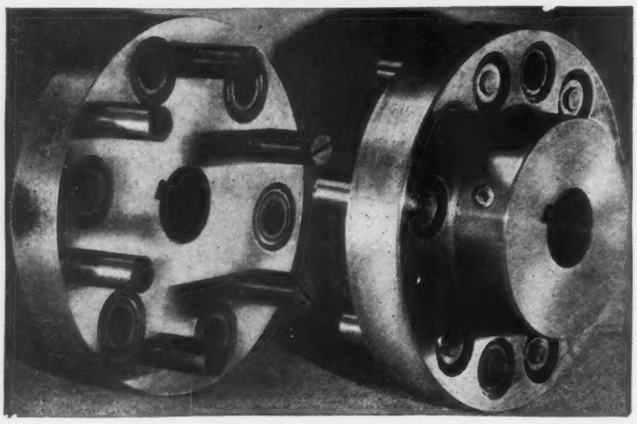
Gearmotors



Totally Enclosed Motors

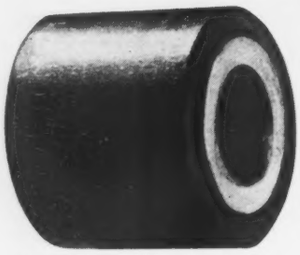
Motors and Control

HOW AJAX COUPLINGS
are built to GIVE SERVICE, not require it

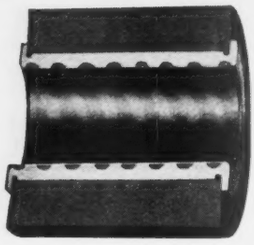


Showing two Ajax Flange assemblies before mating. Installation and maintenance men customarily line up machines by means of these coupling flanges, thanks to Ajax accuracy!

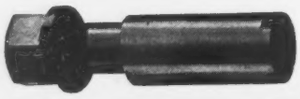
Don't be fooled by the fact that many couplings look about alike on the outside! These photographs show the inside story of how Ajax design and construction combine positive drive, resilient protection against misalignment, free end float, no noise—no backlash, no lubrication worries.



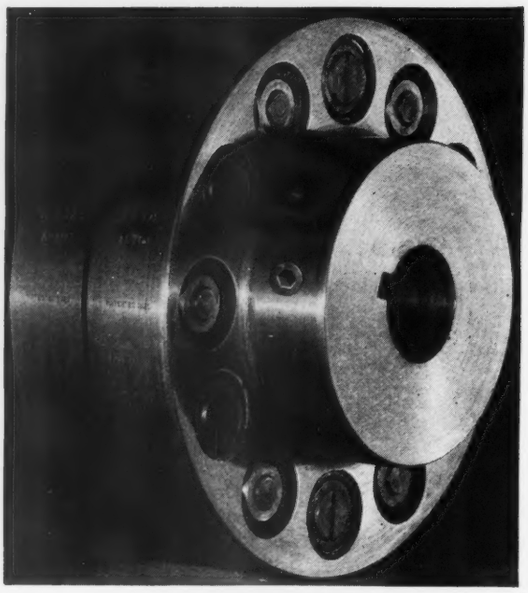
Ajax Rubber Bushings absorb misalignment. Bushing cold-vulcanized to bronze bearing and flange,—no friction, scuffing, shear or wear on rubber.

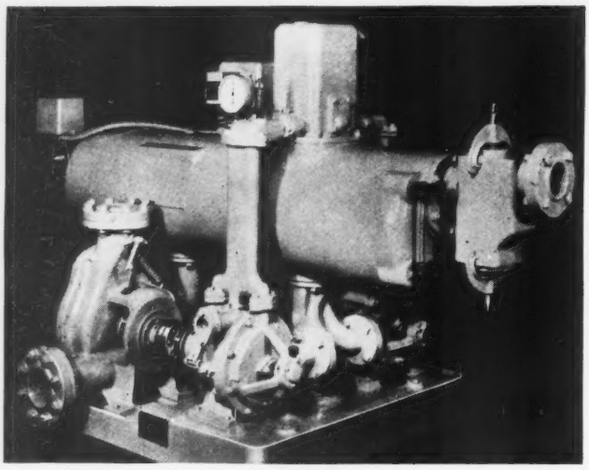


Cross section showing rubber bushing and flanged graphite-bronze, self lubricating bearing.



Alloy steel studs hardened and ground insure accuracy. No noise, no backlash. Positive drive . . . no metal flexing parts to wear or fatigue.





Showing Ajax Coupling used on Jennings Vapor Turbine Return Line Heating Pump built by Nash Engineering Company, South Norwalk, Conn.

Ajax Flexible Couplings are built in a wide range of types and sizes, including Shear Pin models. Wire for useful Ajax Data Book that makes it easy for you to select the correct coupling to fit your job.

AJAX FLEXIBLE COUPLING CO.

62 English St. Westfield, N. Y.

Incorporated 1920

Akron, Ohio	Dallas, Texas	Milwaukee, Wis.	San Francisco, Cal.
Atlanta, Ga.	Denver, Colo.	Minneapolis, Minn.	St. Louis, Mo.
Boston, Mass.	Detroit, Mich.	Montreal, Que.	Seattle, Wash.
Buffalo, N. Y.	Indianapolis, Ind.	New York, N. Y.	Spokane, Wash.
Chicago, Ill.	Kansas City, Mo.	Philadelphia, Pa.	Stuttgart, Ark.
Cincinnati, Ohio	Los Angeles, Cal.	Pittsburgh, Pa.	Syracuse, N. Y
Cleveland, Ohio	Louisville, Ky.	Salt Lake City, Utah	

Also Manufacturers of Reciprocating Shakers and Screens.

NEWCOMER TO SALES STAFF MAKES GOOD!
Gaylord Boxes
THANK YOU, GENTLEMEN, FOR THE CHANCE TO PROVE I COULD SELL AS WELL AS DELIVER OUR GOODS!

Let Gaylord show you how to add power to your merchandising with containers

Are your shipping containers selling as well as delivering the goods? They are for many concerns whose sales and advertising managers have made them a part of their merchandising campaigns.

Through close cooperation with merchandising staffs, Gaylord master designers have recently transformed many shipping containers into hard-working sales makers.

May we suggest you invite your shipping containers to your next merchandising conference? Then, let Gaylord show you how to make the newcomer make good! Phone or write our nearest office for further details. No obligation.

Gaylord Boxes

Also Gaylord Folding Cartons... Grocery Bags and Sacks... Kraft and Specialties.

GAYLORD CONTAINER CORPORATION, General Offices: SAINT LOUIS

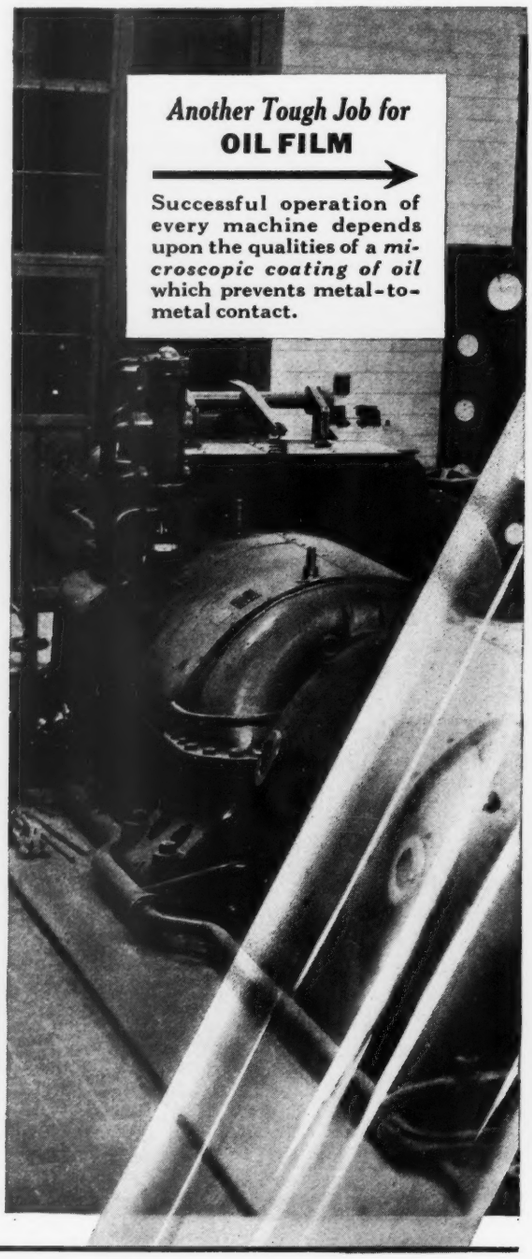
There's a Gaylord plant or sales office in your territory

GARGOYLE D.T.E. OILS

Standard

Since the first days of steam turbines, Gargoyle D.T.E. Oils have been unsurpassed for quality and economy in turbine lubrication.

In protecting the turbines that generate more than half the world's turbo-electric power, these famous oils have proved—that their ability to protect costly machine investments is worth many times their relatively small cost.


Another Tough Job for
OIL FILM
Successful operation of every machine depends upon the qualities of a *microscopic coating of oil* which prevents metal-to-metal contact.

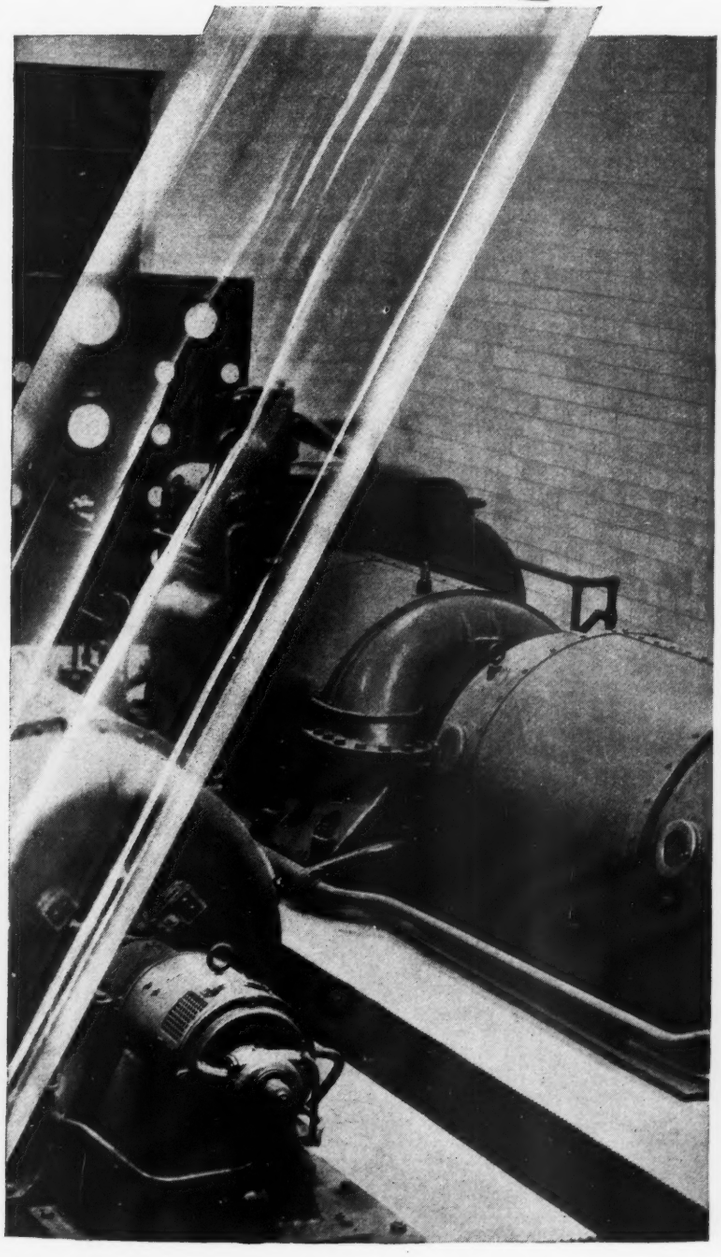
THE SOCONY-VACUUM man offers you a complete line of lubricants, plus these *exclusives:*

The right lubricant for every machine . . . and new lubricants ahead of new needs . . . developed by world-famous research laboratories through close cooperation with machine builders.

73 years' experience—thousands of case histories—to guide in prescribing the right use of these lubricants to gain Lubrication Profits for you.

World-wide distribution and guaranteed uniformity—the same quality available everywhere.

HAVE ALWAYS SET THE of Quality



SOCONY-VACUUM

Industrial Service and Lubricants Help to Lower Costs by

Correct Lubrication

GARGOYLE Lubricants

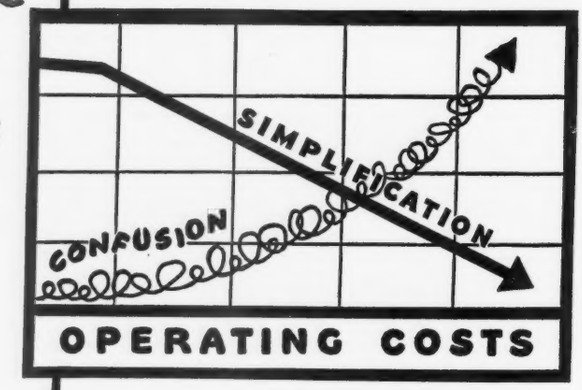
SOCONY-VACUUM OIL CO., INC.

Standard Oil of New York Division · White Star Division
Lubrite Division · Magnolia Petroleum Company
Chicago Division · White Eagle Division · Wadhams Division
General Petroleum Corporation of California

NOT-SO-DIFFICULT DECISION

3 are less trouble than 10!

● Isn't it easier to take three dogs out for a walk than ten? You'll also find it's simpler to carry three Bearing Metals in stock instead of ten or more!



go down when purchasing of Bearing Metals is simplified. Operating costs go up when a large stock of Bearing Metals leads to confusion.

Eagle *Controlled Specifications* minimize Bearing Metal failures

FIRST, because Eagle Bearing Metals are made only of clean, primary metals. SECOND, because Eagle Bearing Metals are alloyed under strict pyrometric control. These controlled specifications assure uniformity and long life. No hard spots to cut and score the shaft. Eagle Bearing Metals are sold through recognized distributors.

Write today for free booklet about Eagle Bearing Metals

EAGLE TIN LOY

An ideal tinning compound that assures an effective lasting bond between the bearing metal and the shell . . . easy to use . . . efficient . . . economical.

These 3 EAGLE BEARING METALS

meet most Bearing Metal Requirements

EAGLE DREADNAUGHT
For extreme speed and pressure conditions

EAGLE OUTLASTA
For medium speed and pressure conditions

EAGLE DURABLE
For low speed and pressure conditions

EAGLE EP PICHER

The Eagle-Picher Lead Company, Cincinnati, Ohio

NO INK TO SPILL

NO PEN TO CLOG

with this **NEW** *low-priced, light-weight recording instrument*

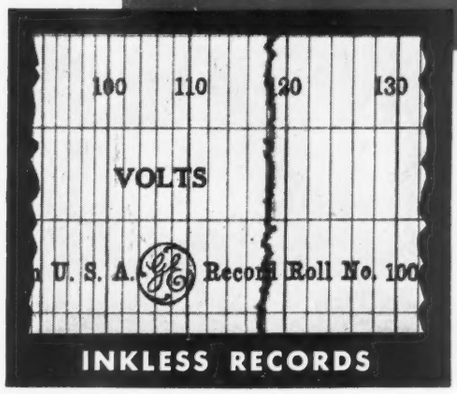
ON those jobs where ink recording has proved troublesome and messy, you'll find that General Electric's new inkless recorder, Type CF-1, gives an accurate, easy-to-read record.

USES NO INK

There's no pen to clog—no ink to "paint" the chart on highly fluctuating loads. And there's nothing to evaporate or spill. In temperatures as low as −10 F and as high as 120 F this new inkless recorder gives successful operation.

IT'S LIGHTWEIGHT

The Type CF-1 is small and compact and light. It weighs only 12 pounds—less than half the usual weight of recording instruments. It's easy to carry around.



← Photograph of actual voltage record made by inkless Type CF-1 recorder

INDOOR OR OUTDOOR USE

You'll like the flexibility of this new inkless recorder. You can use it indoors or outdoors, and you can mount it on a wall or on a pole. Wherever it is, it will give continuous operation for as long as 30 days without attention—a great advantage where frequent servicing is impractical.

IT'S LOW-PRICED

This is the latest word in recorders, and General Electric's newest contribution to measurement savings. It's inexpensive, too. Publication GEA-3187 contains complete information. Call your nearest G-E office for a copy, or write General Electric Company, Schenectady, New York.

HEADQUARTERS FOR ELECTRICAL MEASUREMENT

GENERAL ELECTRIC

GUARDIAN*
BUILDING WIRE

In braided or leaded construction, single, two or three conductors, General Cable "GUARDIAN" is the correct material to specify for your power and lighting circuits . . . Sold by Electrical Wholesalers Everywhere.

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General Cable Corporation Sales Offices: ATLANTA • BOSTON • BUFFALO • CHICAGO • CINCINNATI • CLEVELAND • DALLAS • DETROIT
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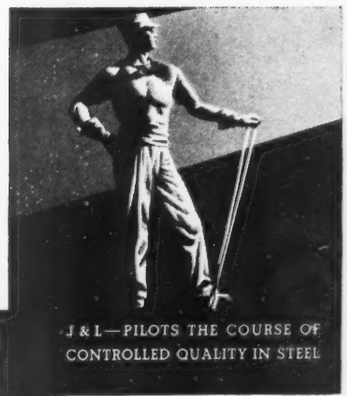
J&L SEAMLESS STEEL BOILER TUBES ASSURE SAFETY AND ECONOMY IN THE MAINTENANCE AND OPERATION OF YOUR BOILERS • • • •

J & L Boiler Tubes keep boilers working efficiently and economically because into every length of J & L seamless tubes is built an extra margin of strength and safety. There are no welds; therefore, there can be no failure at or near a weld — boilers stay on the job longer with fewer costly shut-downs.

When replacements or repairs are necessary, J & L Boiler Tubes form easily, roll in faster and they "stay put." Installations in power and manufacturing plants all over the country are proving that J & L Seamless Steel Boiler Tubes help make maintenance dollars go further.

The next time you need boiler tubes, specify J & L Seamless. Make sure you get tubes that give you low installation cost and last longer. Write today for a copy of the J & L Seamless Steel Boiler Tube Bulletin.



JONES & LAUGHLIN STEEL CORPORATION

AMERICAN IRON AND STEEL WORKS
PITTSBURGH, PENNSYLVANIA

J&L STEEL

J & L—PARTNER IN PROGRESS TO AMERICAN INDUSTRY

AIR OUTPUT *Increased 66%* OPERATING COST *Lower than before*

with GARDNER-DENVER HAF 14" Stroke Air Compressor!

A LARGE midwest industrial plant has increased its air output 66%—and actually decreased its compressor operating cost—by installing a Gardner-Denver 14" stroke "HAF" Compressor. Because the new compressor has resulted in a plant power factor improvement, there is a total saving of $210.00 per month.

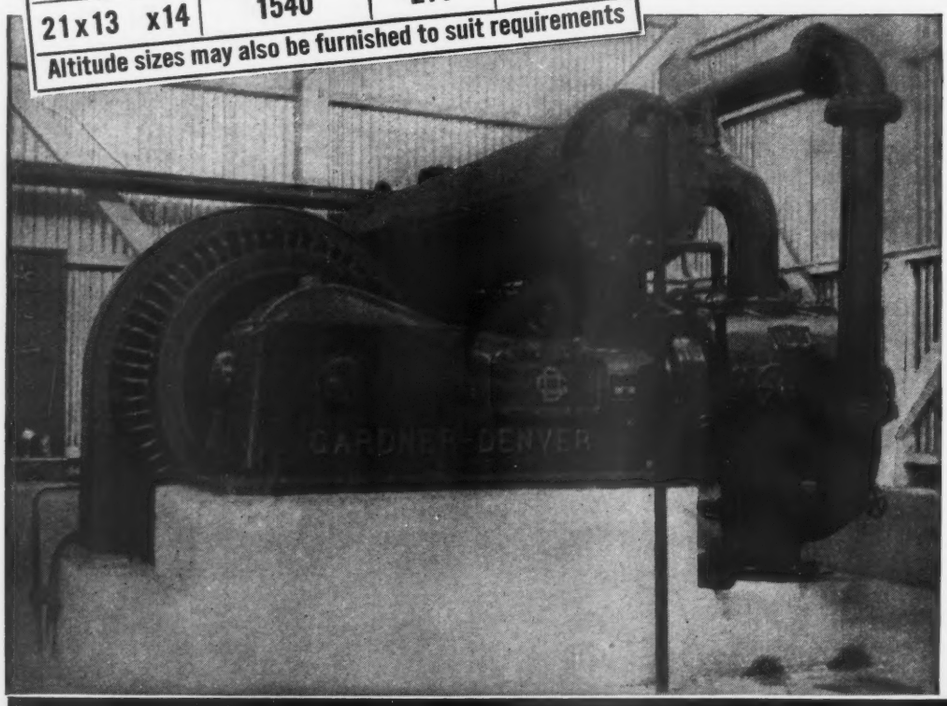
This Gardner-Denver HAF Compressor is equipped with a five-step clearance control regulator, with magnetic control governor—fitting air output exactly to air needs, and thereby preventing waste. This five-step clearance control makes the operation of the HAF absolutely positive and reliable—assures greatest operating economy because the running of the compressor is always regulated in accordance with air needs, and the compressor always starts unloaded. It is estimated that with the savings effected, the complete compressor will pay for itself in 2½ to 3 years.

You'll want full information about Gardner-Denver 14" stroke HAF Compressors—and about the savings they can make in your plant. Write for our bulletin today! Gardner-Denver Company, Quincy, Illinois.

SIZES AND RATINGS
Sea Level

SIZES	Displacement Cubic Feet Per Minute	R.P.M.	Motor Horsepower
20x12½x14	1400	277	225
21x13 x14	1540	277	250

Altitude sizes may also be furnished to suit requirements



GARDNER-DENVER 14" STROKE HAF COMPRESSOR

1. Timken tapered double row heavy duty main bearings. Many "HA" Compressors have been in operation for more than eight years without a main bearing failure—and the great majority of the main bearings have never even required adjustment during that period!
2. Five-step clearance control regulation with magnetic control governor fits air output to air needs exactly.
3. Cushioned Duo-Plate valves—practically noiseless in operation—light—durable. Valves actually become tighter with use.
4. High volumetric and mechanical efficiency—low power and maintenance cost, verified by reports from many satisfied users.

GARDNER-DENVER 80th ANNIVERSARY YEAR

The FASTENERS THAT WOULDN'T STAY PUT —*and the* G.T.M.

YOU'LL have to go a long way to find a meaner drive to belt than that blueprinted here. There are four quarter-turns around four pulleys—*two of them only 8" in diameter*—over which the belt travels at a speed of 4,700 *feet per minute!* And the drive operates between two floors, making it impossible to apply a factory-built endless belt.

This combination of high speed, small pulleys and sharp turns raised Cain with fasteners—yanked them out on an average of once a month, causing costly shutdowns. And in addition excessive stretch made frequent take-ups necessary.

"What can we do about it?" the mill asked the G.T.M.—Goodyear Technical Man. His answer was a COMPASS* "41" Belt—*made endless on the job by Goodyear's patented vulcanized splice*—installed on August 9, 1935.

It was the right answer. Since the day the COMPASS first went on there has not been a single shutdown for belt repair. There have been no take-ups *because there has been no stretch!* Maintenance costs have been eliminated, production stepped up by COMPASS continuous operation—and it is still in good condition.

If you are having fastener troubles why not consult the Goodyear G.T.M. about a COMPASS made endless on the drive? To fetch him, write Goodyear, Akron, Ohio, or Los Angeles, California—or phone the nearest Goodyear Mechanical Rubber Goods Distributor.

THE GREATEST NAME IN RUBBER

GOODYEAR

CENTENNIAL 1839 1939 CHARLES GOODYEAR

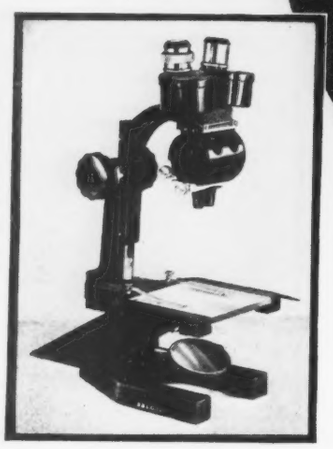
CENTENNIAL OF CHARLES GOODYEAR'S DISCOVERY OF VULCANIZATION

*Trade-mark of The Goodyear Tire & Rubber Company

At *Bausch & Lomb* where accuracy is supreme the tool check was replaced by McCASKEY TOOL CONTROL

Operators using the Bausch & Lomb Contour Projector in testing the meshing of gears.

Below—Bausch & Lomb Wide Field Binocular Microscope used in shop work.



THE importance of being able to see essentials is basic in the business of Bausch & Lomb Optical Company, Rochester, N. Y., manufacturer of optical instruments for industry, research and education. Naturally, McCaskey *visual* controls providing speedy, economical and accurate tool crib service appeal to them. Mr. Harry Catteau, Supervisor of the McCaskey Control used in Bausch & Lomb, tells us why in a very few sentences:

"A great variety of tools must be available for the production of our many types of precision instruments. More than ten years ago, we appreciated the necessity of a thoroughly dependable crib system, if tool costs were to be reduced to a desirable minimum.

"The disappearance of tools has been stopped entirely and arguments about tool responsibility long have been a thing of the past. Crib service is speedy and there is no loss of time looking for tools that have been loaned to employees. The McCaskey System gives us complete control over every item at all times. Varying conditions have been easily handled because of the personnel as well as the management."

"The crib supervisor, his attendants, and the employees drawing tools, all prefer McCaskey. It has been satisfactory in every respect to the operating personnel as well as the management."

WHETHER you have one or a dozen cribs, production or maintenance tools, McCaskey Control will cut your tool costs. Write for "Fix Tool Responsibility" and complete reports of the actual savings effected by three other representative manufacturers. Or, without obligation, let us outline McCaskey Tool Control for your specific needs. Write today.

THE McCASKEY REGISTER COMPANY, ALLIANCE, OHIO

McCASKEY INDUSTRIAL CONTROLS

PRODUCTION • INVENTORY • MAINTENANCE • TOOLS • COSTS • PAYROLL

Gulf research men develop better lubricants–help industry reduce plant operating costs!

This "chemist's aquarium" is used by Gulf technologists to measure the slightest chemical change in an oil resulting from oxidation. The data secured are valuable in studying means of combatting one of oil's greatest enemies—oxygen.

This experimental equipment is used to test bearing lubricants under a wider range of operating conditions than are encountered in actual service, thus insuring an extra margin of operating safety for specific applications.

Production flows more smoothly, machines last longer with less "time-out-of-service" when Gulf's higher quality lubricants are used!

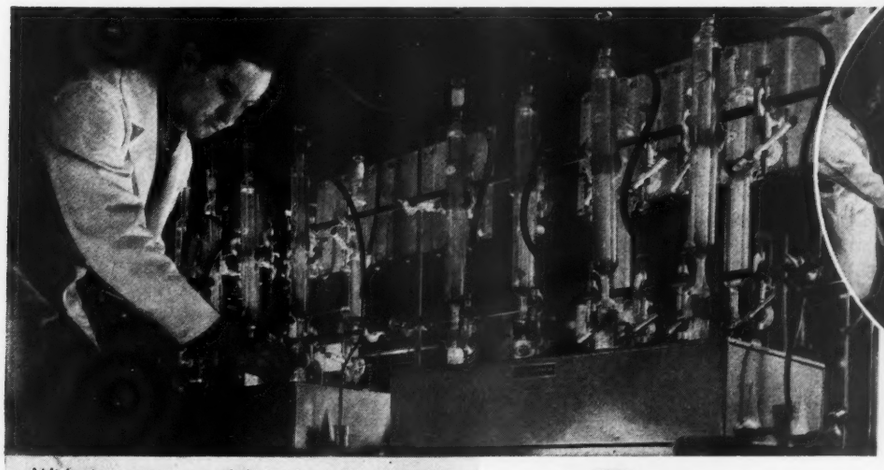
PICTURED here are a few typical scenes in Gulf Research Laboratories. Gulf technologists, not content with the usual service tests for oils and greases, have devised instruments which can predetermine certain performance values of oils in specific types of service.

Some of these instruments find ways to make oils oxidize and break down under conditions many times as severe as are encountered in industry's machines. Others make delicate measurements of oil deterioration in an environment which simulates actual service.

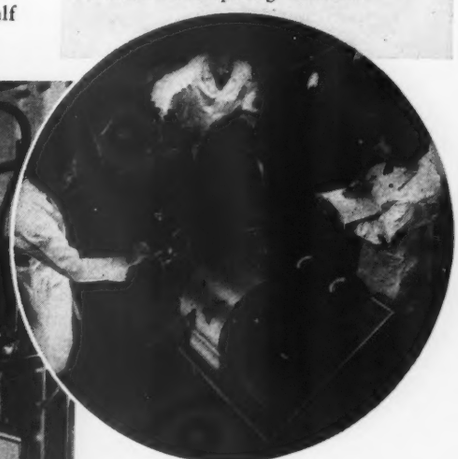
Thus Gulf scientists and engineers strive each day to raise the quality standards for oils and greases, supplementing with newly discovered facts the knowledge gained through field contacts with thousands of lubrication problems each year. And industry is assured of lubricants which will prolong the life of costly machinery, keep it operating more efficiently *with lower costs for maintenance.*

If you want your machines to last longer, operate better and at lower cost, call in a Gulf lubrication engineer and ask him to recommend the proper oils and greases for them. Gulf Oil Corporation — Gulf Refining Company, Pittsburgh, Penna.

Vibration is a major problem in the operation of many machines and devices. The Gulf scientist shown above is working with special apparatus designed in the Gulf laboratory to measure spindle vibration and to study the effects of lubricants on dampening vibration.



With this apparatus, lubricating oils are oxidized in the presence of water and metals, and the oils are examined from time to time for properties. One year of life in this test is equivalent to about seventy years' use for a lubricant in certain types of service.



Here Gulf technologists are shown working with an experimental Diesel engine, studying Diesel lubrication problems. They find that ring sticking, cylinder wear, gum formation and objectionable deposits have been minimized by the proper use of the right grades of Gulf's higher quality Diesel lubricants.

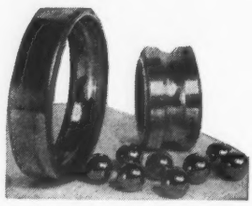
GULF INDUSTRIAL LUBRICATION

WHY ANTI-FRICTION BEARINGS?

Everyone knows this inevitable result of Wear due to friction. Yet . . . the sliding, scuffing contact of countless feet on granite is as nothing in wear potential compared to the contact of metal on metal—in modern machinery, under heavy loads, at high speeds.

During the useful life of an ever increasing number of modern machines, the bearings make millions or even billions of revolutions. And these machines stand up! For friction is practically eliminated in the ball bearing as perfected by New Departure, and Wear is less than in any other type of rolling bearing.

For interesting brochure, BT-12, "How Wear *Wore Itself Out,*" write to New Departure, Division General Motors Sales Corp., Bristol, Conn.



. . . and still going!

In this New Departure ball bearing, which had made 35,000,000 revolutions under load, the original finish was perfect and Wear for all practical purposes was not measurable. Think what that kind of "wear prevention" means in lower maintenance and longer machine life!

NEW DEPARTURE

THE FORGED STEEL BEARING

2791

FACTORY
MANAGEMENT AND MAINTENANCE
L. C. MORROW, Editor

Airing the Labor Mess

HAS THE NATIONAL LABOR RELATIONS BOARD been fair and impartial in its conduct, in its decisions and in its interpretation of the National Labor Relations Act?

What has been the effect of the labor law upon "increasing or decreasing disputes between employer and employee, upon increasing or decreasing employment, and upon the general economic condition of the country"?

What amendments to the Act are desirable to more effectively carry out the intent of Congress and what changes, if any, are desirable in the administration personnel?

Has the board attempted interpretation and regulation not justified by the language of the Act?

Should Congress legislate further to clarify the term "interstate commerce," and to attempt to improve the employer-employee relationship?

These are the questions for which the House of Representatives has voted to seek answers in its investigation of the National Labor Relations Board by a five-man committee. These are questions that need answering.

If, as the Board contends, it has made its interpretations and rulings in accordance with the intent of the law, it has nothing to fear in the way of censorship of its administration.

If the House Labor Committee is not stalling, its objection to the investigation on the ground of duplication is not well founded. Obviously it can place the testimony it has collected at the disposal of the new committee.

If it turns out that the Board has acted in all cases without prejudice, but, also, that industrial strife has increased rather than diminished, the House—and the public—can conclude only that the Act needs revision.

All of the government factions concerned now have the opportunity of achieving what all of them profess to want—a fair law that will bring about industrial harmony. The five-man committee, if it will lay aside personal prejudice and preformed opinion, has a grand opportunity to spread the facts before the public.

Those facts, in our opinion, will show that neither Board nor Act is all it should be. The Act is too stringently in favor of organized labor. So is the Board. The whole labor mess needs airing.

L. C. Morrow

Drive for Closed Shop Is On

Despite major setback, issue looms large in labor strategy as unions fight to hold ranks. Consolidation, not expansion, is the trend. "Organized" plants to bear brunt

CHARLES B. COATES

Assistant Editor

UNNOTICED IN THE CLAMOR of factional rivalries, the closed-shop issue looms larger than ever in today's national labor scene. More man-days of industrial production were lost in closed shop strikes in 1938 than in any year since 1927. The accompanying charts, based on statistics of the U. S. Labor Department, show the trend. Recognition strikes have fallen off sharply since the organizing boom of 1937, while jurisdictional and factional disputes are gaining in importance.

The trend bids fair to grow. It gained great impetus from CIO's "union shop"* victory in coal. Lesser triumphs, before and since, have encouraged labor to push for contractual assurance of its revenues and enrollments.

The drive met its first major setback of the year, however, in the Allis-Chalmers strike at Milwaukee in June when Local 248 of the United Automobile Workers went out amid demands not only for the union (closed) shop but the check-off as well, and came back quietly two weeks later with neither objective attained.

Spanked the Union

Meanwhile a riot occurred of the sort that was bound to estrange the exceptionally conscientious and generally pro-labor Milwaukee public. And did. At the strike's end, the strong *Milwaukee Journal*—which has often been damned on its own doorstep as a radical labor paper—spanked the union soundly. The strike gained nothing that could not have been gotten in negotiation, said *The Journal*, and it cost the workers $600,000 in wages, equal to a 7 per cent pay cut for the year.

The story of the Allis-Chalmers strike is one for both management and labor to study with profit to themselves and to industry.

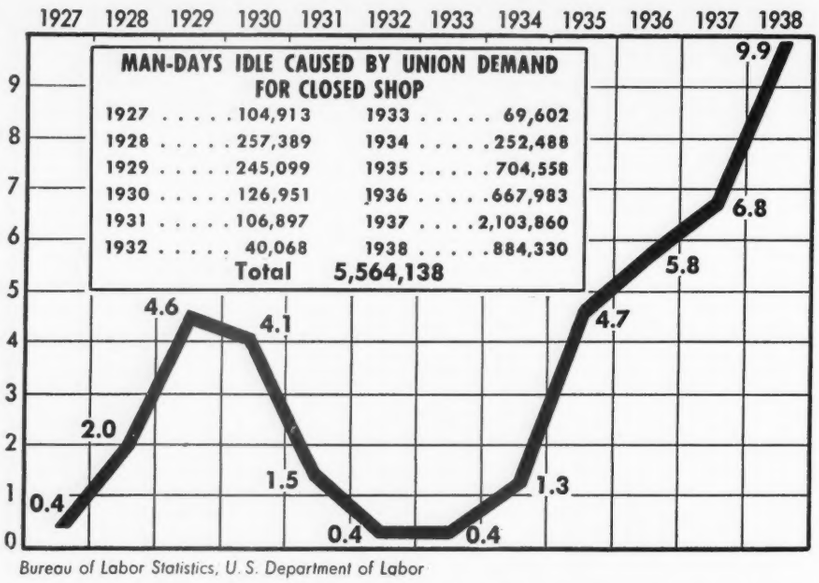
It is the story of an aggressive, militant union leadership (Local 248 is one of the UAW's lustiest "prize babies") versus a seasoned management in a battle in which there was no outstanding question of wages, hours, or the other more familiar points of labor controversy. Instead the closed shop and check-off demand took the spotlight. The union now denies that the check-off was involved. But the issue was plainly written in the first draft of its 1939 demands on the company.

To this the management said "no" so decidedly and so consistently that the negotiations shifted to questions of grievance procedure. These negotiations rambled along for three months, getting nowhere. The company offered to renew the 1938 contract, but the union canceled it. The company then offered a proposal for the 1939 contract so much like the 1938 agreement that it would take a lawyer or a union leader to ferret out the difference. There were, however, two changes. The proposal would have kept union officers out of the early phases of the grievance procedure, restricting them to later discussions with company officers of corresponding rank, and it would have caused members of the union bargaining committee, eight in number, to receive half instead of full pay for time spent in handling grievances.

As expiration of the 1938 contract drew near, a slowdown set in, flared into a "holiday," and burst into a full-fledged strike. A riot ensued, during which the Sheriff (Allis-Chalmers is in West Allis, just outside Milwaukee) called on Governor Julius P. Heil for troops. The Governor, refusing, entered as mediator a troubled picture in which an able federal conciliator was already working hard. Presently a revised 1939

HOW CLOSED SHOP HAS GROWN AS STRIKE ISSUE

(As Percentage of Total Man-Days Idle)



Bureau of Labor Statistics, U. S. Department of Labor

As a strike issue, the closed shop has climbed steadily in importance, hitting a new high in 1938 when it caused 9.9 per cent of the total man-day lost in strikes. Even when "recognition" strikes declined 66 per cent after labor's big organizing drive in 1937, the closed-shop issue continued to gain. Trend continues strong this year as labor seeks to consolidate its present strength. Factional warfare is also a cause

* "Union shop" is a form of the closed shop. The difference is a slim one, but it is a difference that labor usually emphasizes. In a completely closed shop, only union members can be hired. In the union shop, the management can pick its own new employees, but they must join the union after they are hired.

But Stalls at Allis-Chalmers

Stones struck trolley cars bearing Allis-Chalmers office workers to strike-bound plant. Tear gas was thrown. Thirteen were hurt

contract was proposed by the company and ratified by 97 per cent of the union membership. (Presumably it will be in force until 1940, although it is not yet signed.) The men went back to work.

The new contract, as ratified, also resembles the 1938 agreement so closely that it would take a whole corps of lawyers or a whole squad of labor leaders to discover the difference. Yet the union canceled the 1938 agreement, struck against the first 1939 proposal, and accepted the second, almost by acclamation, as a notable victory. Why?

Because, says the union, the company agreed orally, during the conferences with Governor Heil, to take disciplinary measures against anti-union employees in the shop.

No such thing, says the company. It vehemently denies the existence of any oral or side agreement with the union "as a part of or consideration for the proposal for the 1939 agreement which was accepted by a 97 per cent vote of the union." But on the other hand, the company states, since the time when Local 248 was certified, after an NLRB election, as exclusive bargaining agent for the West Allis production employees, the company has had a "true open shop" policy as incorporated in a statement it published in 1938. The statement follows:

"The company shall not help any employee form other groups or unions which would weaken this union (Local 248) or make it lose members. This does not mean, however, that every employee must join the union. The union cannot force an employee to join the union, but on the other hand *no employee who stays out of the union will be permitted to talk against the union on company premises.*"

The union says, but the company denies, that there was also an oral compromise on the union's demand for uniform negotiation of contracts in the West Allis plant and of those in the company's Boston and Pittsburgh plants where the CIO United Electrical and Radio Workers have bargaining rights. At the height of the strike, the union added to its platform demands for wage increases larger than the company's earnings of the previous year. No wage increases were included in the final settlement, however, although vacation schedules were slightly liberalized. The privileges of union officers to enter the plant were, if anything, restricted (although the union denies this), but the bargaining committeemen will remain on full pay during negotiations.

When you take all these points and add them up, no matter how they were settled, you will still have trouble in making them total a strike. They are

all issues of the sort that collective bargaining is meant to settle by negotiation. For observe—no wage reduction was proposed by the company, and no wage increase was demanded, at the outset, by the union. Hours, overtime, general working conditions were not in question. The company was not accused of anti-union activity. The Labor Board has never even brought to hearing an unfair practice charge against it. Opposition to the union sprang, instead, from a small but clamorous minority among the wage earners—some independents and a few surviving followers of Homer Martin, the AFL insurgent.

Down to His Last Four Badges

Why, then, a strike? Why mass picketing outside the plant involving some 9,000 persons, overwhelming West Allis's tiny police force, and harassing the Sheriff who was down to his last four deputies' badges before the thing was over? Why a deadlock that gave the West Allis Board of Aldermen visions of a strike lasting two months at such cost to the community that a $4 per thousand assessment might have to be levied on property? Why rocks hurled through the windows of trolley cars bearing incoming office workers? Why tear gas and 13 injuries in a single day? (The score: Police and Deputies 10, Strikers 0, Bystanders 3.)

Because—now let's take the testimony of those who look at the matter from an employer's point of view:

1. The union knew it was losing employee support because it had made about all the gains it could as to wages and working conditions.

2. It had to call a strike in order to solidify the membership against the encroachments of the insurgents.

3. The strike vote itself was probably rigged by the union leadership, which controlled the balloting and did its own checking and counting.

4. The union is in the hands of a Communist clique, and the President, Harold Christoffel, was exposed as a Stalinist by a former party member, Farrell Schnering, in a legislative investigation at Madison last June 22.

5. Governor Heil should have sent in troops and opened up the gates to admit the office workers, who had clerical work to do in connection with Allis-Chalmers branch plants outside West Allis employing more than 5,000 persons.

6. The men hadn't wanted to strike and hadn't been told why they were striking.

Now for the union sympathizer's version of the affair:

1. There was need for a strike because the company's first 1939 contract offer would have "strangled the union to death."

2. What's wrong with the closed shop, anyway? Lots of plants have it. It isn't a matter of forcing men to join the union but of protecting the union's existence so that the benefits of unionism may be preserved for all.

3. The closed shop would improve the morale of the men by silencing the dissenters.

4. Governor Heil took a "firm and understanding position" in the negotiations.

5. The Schnering testimony was "just another Dies Committee attempt to discredit the union leadership."

6. The agreement finally secured in the strike was as effective as the closed shop and the union's enrollment is now 98 per cent of the eligible total.

Who won the strike? To the great world outside, it will go down as a decisive management victory because Allis-Chalmers did not concede the closed shop or the check-off, and this undoubtedly will be a deterrent in other union circles. The union insists, however, that the strike was successful.

The Allis-Chalmers strike was selected for this analysis because it illuminates so clearly the new emphasis that labor is putting on the closed-shop objective. Factional disputes are closely linked to this drive. In fact, "rival unions or factions" and jurisdictional disputes as a cause of strikes have risen almost parallel to the closed-shop issue, hitting a new high in 1938 and causing 9.5 per cent of the man-days lost

But strikes are not always won or lost at the point of impact. It often remains to be seen which way public opinion—and this bears heavily on employee opinion—will lean in the long run. On the public relations side, the company emerged with much the better of the battle. It put the union in the position of striking frankly for the unpopular closed shop. (In rebuttal, the union contends that this merely educated the public to the need for the closed shop.)

Another effect of the strike was to focus attention on the fact that the company has been honest in its dealings with the union and that its labor policies are more than usually liberal. Keystones of the company's policy, as described by Vice-President H. W. Story, are "fairness" and "firmness." The first means you must deal honestly with labor, if only for your own satisfaction, and the second means that you've got to keep control of the operations of your own company.

The company scored strongly with an advertisement in *The Journal*, during the strike, in which it explained its responsibility to its 17,000 stockholders and made clear its stand on the closed shop and check-off. This was perhaps its first venture in this direction, for while Allis-Chalmers has the basis for good public relations—good labor policies—it has never made a systematic effort through the press to place its viewpoint before the people of the city.

Labor Seems Likely to Learn

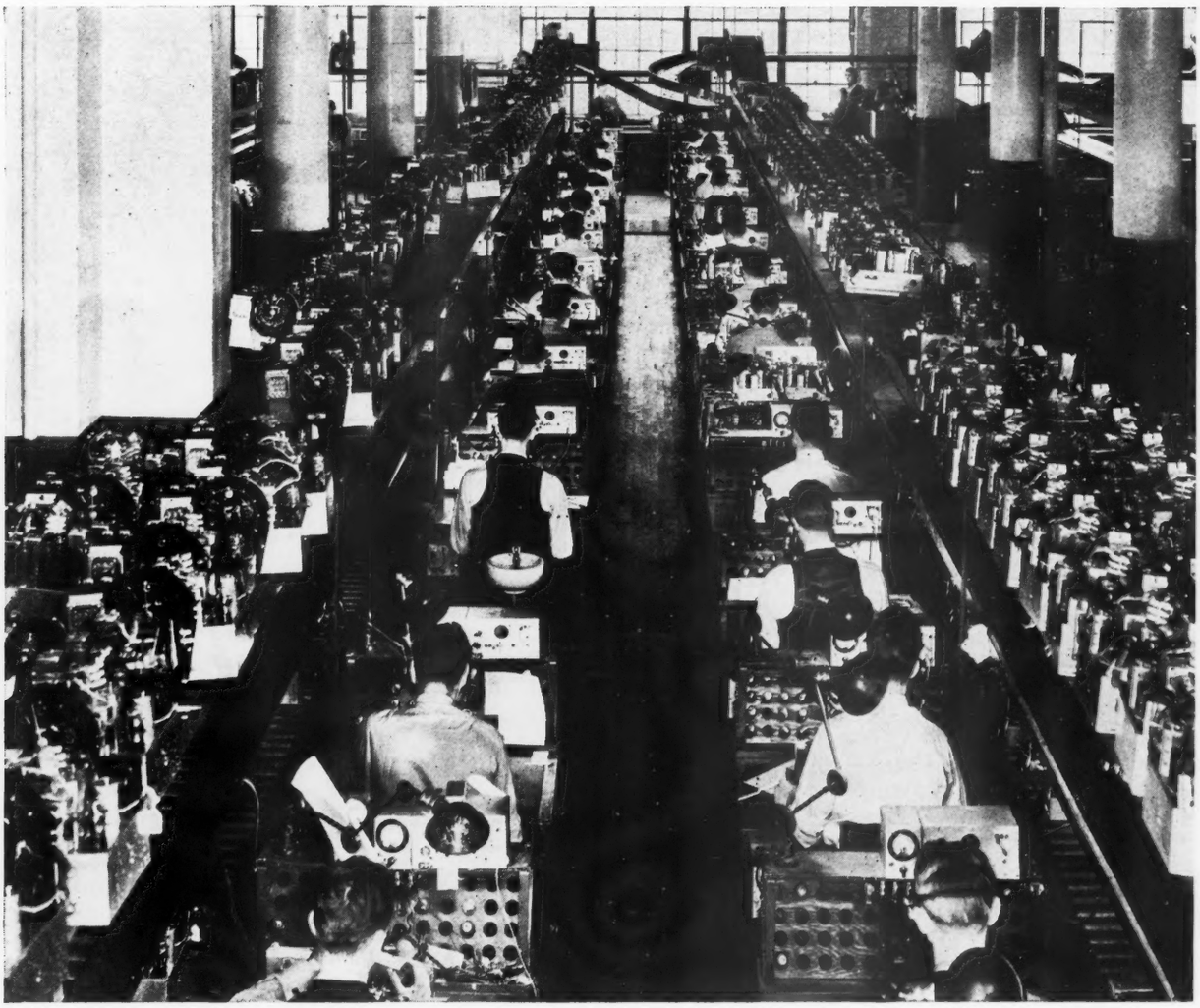
One of the most instructive points, to management, in the Allis-Chalmers strike is the importance of being consistently fair. Time will tell, but labor seems likely to learn from this instance the unwisdom of staking a strike on the closed-shop issue, especially when dealing with a management invulnerable to the usual charges of low wages, sweating, refusal to bargain, insincerity, or unfair practices. If you were to shop around Milwaukee a bit, sampling the opinion of this one and that one, you would be willing to bet that the public wouldn't stand for another closed-shop walkout at Allis-Chalmers.

Industry sees in this picture an example of labor relations in a new phase which, in management terms, could be described as one of consolidation, rather than expansion. AFL and CIO will continue, with one hand, their private duel. But they face employers sidewise with a strategy that is much the same because their problems are much the same.

The problems are how to hold their ranks, each against the raids of the other; how to offset the loss of public support (induced in large part by their own warfare); how to meet, in some quarters, a considerably stiffer management attitude; and how to overcome the apathy of some thousands of their own hastily recruited new members.

To all these questions, the closed shop is organized labor's best answer. If there is any point on which William Green and John L. Lewis agree, that is it. The closed-shop contract shuts the door to rival unions, terminates employer resistance to unionism as such, silences opposition within the ranks, and enables the union to get along, if need be, without public support.

Thus, while the push for new members will continue at a somewhat diminished pace, the brunt of union activity in the immediate future seems likely to fall upon employing companies whose workers are already organized.



Two of Zenith's sixteen final assembly lines, each served by a 3-level conveyor. Note aisle cross-over at far end of department

Zenith Goes to One-Floor Flow

Gone are delays and costs of backtracking; continuous flow means closer supervision at lower supervisory cost

ARTHUR VAN VLISSINGEN

Consulting Editor

AS ZENITH RADIO CORPORATION grew, its plant facilities developed on a catch-as-catch-can basis. Eventually the plant occupied four buildings, multi-story and detached from one another, even separated by streets. The handicaps to efficient production and the non-productive expense involved in handling and cross-hauling were obvious.

Some two years ago the company purchased a large plant that had been vacant since mid-depression. Whereupon the management faced the job of working out a production flow that would yield the best product at the lowest operating cost. The task was to accomplish this with equipment involving a minimum of loss in the event of future rearrangements of the plant.

That purpose has been achieved. Practically all equipment can be picked up and moved to other locations with a surprisingly small expense in time, skill, or effort.

The plant layout from the standpoint of production flow is reasonably conventional. It contains two major divisions, one making radio receiving sets for household use, the other for automobile use. The first occupies two-thirds of the plant; the second, one-third. Incoming materials arrive at a receiving platform between these divisions, and divide according to destination. The layout plans are essentially similar, so this explanation will be confined to the household division.

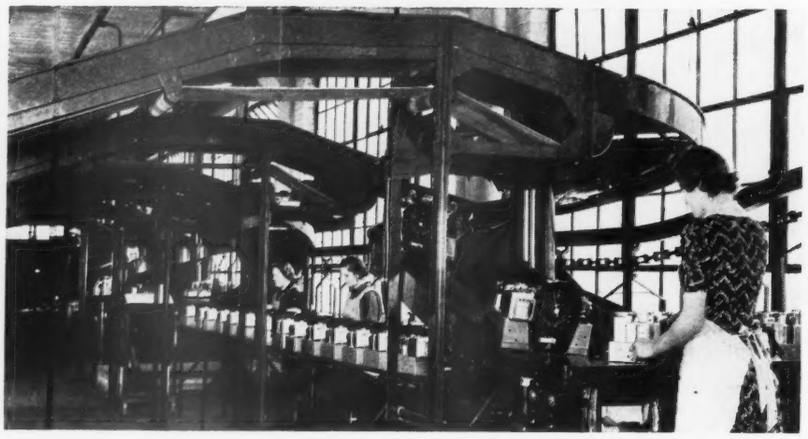
The receiving department adjoins the truck drive. Incoming materials and

parts enter the receiving room and are verified as to quantity and apparent good order. On the direct line of flow from here to the first manufacturing operation, lie the raw materials inspection department and the stockroom.

Parts requiring 100 per cent inspection or anything approaching it move from receiving into incoming inspection, and are cleared through that department. On sampling inspections where gages and the like are portable, instead of moving the material into the inspection department a man comes over with his tools and makes the inspection, thus saving a great deal of needless moving. The adjacent location of these departments was so designed in part to permit examination in this economical manner.

Materials that have required inspection in the inspection department move on through and emerge close to the first manufacturing operation, where they are left during the rest of the working day. Materials that were sampled and passed, remain in the receiving room and are not handled into the stockroom at once, even though it is next door.

That night the stockchasers come to the receiving department and truck the following day's supply of parts to the point of use along the assembly line.



Inspected sets move up and across the aisle via belt conveyor, slide down to the four girls who serve the sixteen lines. Girls do a few clean-up jobs, then place finished chassis on empty trays of overhead chain conveyor that takes them to cabinet assembly

If the receiving room contains none of a given part, or not enough for tomorrow's requirements, the stockchaser obtains the deficiency from the stockroom. If the shipment received and passed by the inspectors is more than the next day's needs, the surplus is taken into the stockroom and stored. Remember that the stockroom is adjacent to receiving and right on the way to the head of the assembly lines.

First operation in making a set is to rivet to the chassis form all brackets, sockets, and other parts upon which the internals of the chassis will be assembled. This occurs at four short lines adjoining the end of the stockroom, where tomorrow's requirements are riveted today. Then at night the riveted chassis move across an aisle to the eight assembly lines, each line extending along a 200-ft. row of assembly tables placed end to end. These tables are made in 8-ft. lengths, and fixtures

Overhead chain conveys finished chassis round long loop serving cabinet assembly lines, doubles as carrier and moving storeroom

to serve them are designed in units sufficient for 16 foot of table, so that two tables are for layout purposes considered as one.

Chassis move along this table not by conveyor but by hand push. All operations are timed to afford each operator ample opportunity to complete her individual task. No conveyor or belt dictates the timing. Better work is the result. Each chassis stands on a wooden base which looks like one side of a small crate. When an operator finishes her task she lightly pushes the chassis along to the next operator—they are stationed every 36 inches along the line. A short push is quite enough.

At the end of the line the chassis moves on to be balanced electrically, and the wooden base is pushed down between the tables, where it falls upon a fast-moving belt conveyor. This conveyor, installed out of sight, delivers the wooden base back to the head of the line to repeat its trip.

Work-in-process inspection occurs at stations along the assembly line, with inspectors spotted regularly according to the requirements of the particular set. In general, inspectors are so placed as to insure complete and efficient examination of the chassis while in motion on the assembly line. After the chassis have been completely assembled and the tubes inserted, each of the eight lines terminates in two inspection lines.

This inspection operation is performed serially by several men on each line. There are various types of inspection. Some of the inspectors check the sets for wiring and permanence of soldered joints. Others inspect mechanical parts and assembly, such as dials, condensers, mountings, sockets, etc. Still others make electrical inspections of various kinds.

Following these inspections the sets are electrically balanced so that the stations come in at the proper points in the dial. Each inspection line is equipped with three gravity roller conveyors, one above the other. The top conveyor has a stop at each inspector's station. He takes off the set, inspects it on his table. If it passes, he replaces it on the conveyor, and it moves to the next inspector. If the set is not perfect, it is placed on the next lower conveyor and rolls along to a repair man who remedies the defect and then places it on the bottom conveyor on which it moves back to re-inspection.

Four Serve 16 Lines

At the end of the line the inspected set moves across an aisle on a belt conveyor which raises it to a height to keep the aisle clear and then lets it slide down to an operator seated across the aisle. Four operators serve sixteen inspection lines. Each operator performs a few well-planned operations such as removing the serially numbered ticket showing that all inspections have been made, wrapping up the cord that has previously been in use for inspection, and so on. The finished chassis without a cabinet is placed on an empty tray of an overhead chain conveyor that passes the end of all assembly lines at right angles.

This chain conveyor, more than 2,000 feet long, carries the sets around a long double loop serving all the cabinet assembly lines. The conveyor contains three times as many trays as are required for full production. Thus, if there is a temporary failure of supply of a given cabinet or part anywhere farther along the line, there is little likelihood of a "pile-up" that might flow back to previous operations and bring them to a standstill. The surplus is stored upon the conveyor and requires neither floor space nor added handling.

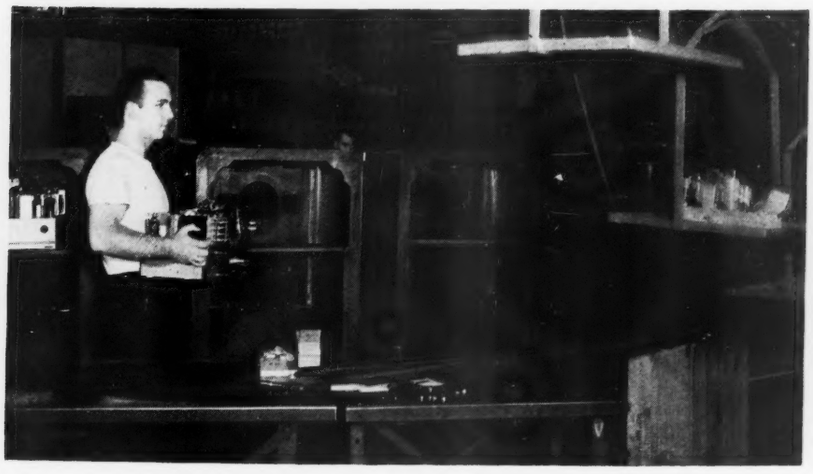
Cabinets are received from suppliers by railway freight in cars at the platform running along the entire side of the plant opposite the point at which the smaller parts are received. They are received in the cartons in which the finished sets will eventually be shipped. The cars containing the cabinets for the morning's production are spotted at the end of the siding closest to assembly. Cabinets are set on dollies and pushed to the head of the assembly line.

There are four lines where chassis are assembled into cabinets—two for consoles, chairside models, and larger units, and two for table models. Incidentally, console assembly lines are placed nearest to the shipping platform, to minimize handling this bulky material. The table model lines are over in the middle of the building, since 50 table model cabinets or sets can be handled on a dolly whose capacity is only four large consoles or chairside models.

After final assembly and final inspection, the unit has arrived at the point where it meets the conveyor of empty cartons. The set is replaced in the carton, sealed, and placed on a dolly for moving to freight car or outbound motor transport.

As has been pointed out, cabinets come in at the point on the siding closest to the point of use. Cabinet storage space is close by, if needed. However, the loading platform has a 22-car ca-

(Continued on page 104)



Junction point where the overhead chain conveyor dips down to meet one of the cabinet assembly lines. Chassis are removed from trays as needed and mounted in the cabinets

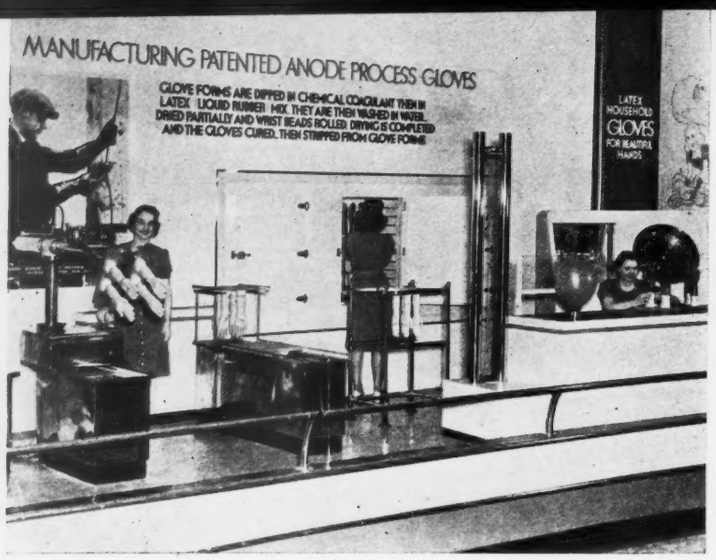
Men Over Forty

"The 'Men Over 40' stir that has been encouraged in many quarters in an attempt to discredit industry caused us to canvass our own organization to determine if we were as bad as some would have the people believe," says Monsanto Chemical Co., of St. Louis.

Results of the survey are published in the July issue of "Monsanto Magazine." They show that 34 per cent of the male employees of Monsanto's ten plants are over 40. This compares with 42.5 per cent of employable males in the United States over 40. Percentages of men over 40 vary in the ten plants as follows: 12.5, 30, 31, 31, 32.5, 33, 40, 43, 60, 66. The four oldest plants, no one of them yet 40, employ the four highest percentages of men over 40.

Monsanto concludes: "Like the equator, age 40 is an imaginary line—figures show fatal 40 is a mental and a headline ghost."

House of tomorrow? Pittsburgh Plate Glass demonstrates possibilities of glass as a basic building material. Garden side is of transparent glass; on street side, glass blocks let in light, yet insure privacy


MANUFACTURING PATENTED ANODE PROCESS GLOVES
GLOVE FORMS ARE DIPPED IN CHEMICAL COAGULANT THEN IN LATEX LIQUID RUBBER MIX. THEY ARE THEN WASHED IN WATER, DRIED PARTIALLY AND WRIST BEADS ROLLED. DRYING IS COMPLETED AND THE GLOVES CURED. THEN STRIPPED FROM GLOVE FORMS
LATEX HOUSEHOLD GLOVES FOR BEAUTIFUL HANDS

Out of the research laboratory has come the anode process glove, a far different product from the rubber glove of yesterday. It costs less, fits better, wears longer. Here Goodrich shows how it's made

Better Things for Better Living

Without accurate gages, mass production of quality goods would be no go. That's why Ford for one uses 235 sets of Johansson blocks to check the 38,000 precision gages in daily use at River Rouge

Seen at the New York World's Fair

When higher standards of living are enjoyed, America's wage earners will enjoy them. American industry justifies this faith in the future by making available to the *many* the better things that once could be enjoyed only by the *few*. Back of industry's ability to do all this are the millions it spends on research, on methods, on equipment. For example . . .

Air conditioning, just a couple of words to 1929 householders, is a reality to thousands of 1939 home owners—all because industry is bringing units like this one of Carrier's within reach of the many

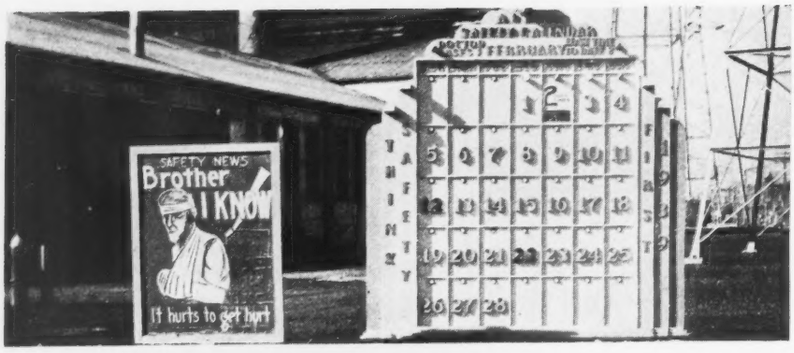
To make low-cost production possible, industry invests countless millions in better handling; spends other millions to protect its property. This hoist and this fence shown as part of American Chain exhibit at the Fair

Much of industry's ability to produce better goods at prices more and more people can pay, may be attributed to its investments in machines of ever greater productivity, and equipped, of course, with anti-friction bearings

Du Pont employs 1,100 chemists, spends $7,000,000 a year to find new products, improve old. Small slice went into development of synthetic musk from coal, bigger slice into nylon, used to make girl's stockings

To produce at low cost, expensive machinery must be insured against breakdown. Continuous running of this relatively costly loom is virtually guaranteed by an inexpensive 1-hp. Westinghouse textile motor

Swapping Ideas Betters Safety

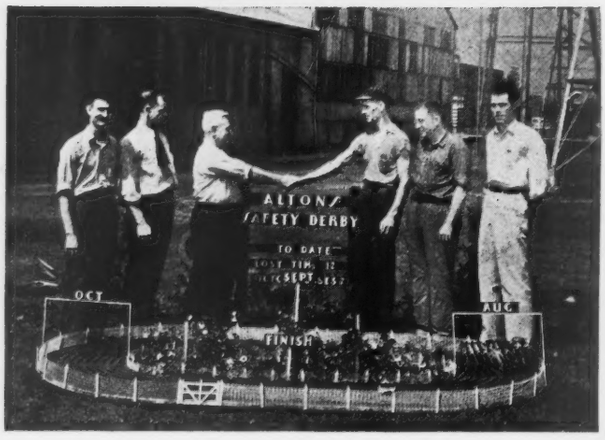


If variety is the spice of life, it peps up safety campaigns too. Owens-Illinois pools safety ideas worked out in its many plants, reports *all* schemes to *all* plants, so lots of good, useful ideas don't go into the discard

J. F. ANDREWS
Assistant Editor

"I SUGGEST THAT YOU carry through the idea of canvassing all plants for their most successful safety promotion ideas and that these thoughts then be grouped together in project report form for issuance to all factories which wish a copy."

With this simple request M. M. Olander, Personnel Director of Owens-Illinois Glass Company, started a free exchange of successful safety promotion ideas among the company's many scattered plants. All of the plants



To give zest to its safety work the Alton plant used "flash programs." Large displays in the yard, placed where all could see them as they entered and left the plant, kept the safety idea alive. At top is a display made up of calendar and safety poster. If an accident occurs, a card describing it is hung in the panel for that date, and the light over the panel is changed from white to red or blue. Center, the safety chain. Link of a department having an accident is detached and allowed to hang down, showing a break in the chain. Rest of the chain does not drop because it is supported from behind. Bottom picture shows head of department winning the safety derby as he receives congratulations

Name of person having an accident is added to the lists on this safety clock in the Central Mold Shop of the Fairmont plant. Lost-time cases are listed at left, doctor's cases at right, while the center space above the dial is reserved for "today's new member"

Programs

wanted to push safety harder in 1939, and a number of them had asked, "What are other plants doing?"

To get the answer, all plants were asked to describe the safety ideas that had worked best in their 1938 campaigns. All answers were tied together in an illustrated report issued by the central personnel division, copies of which went to all plants. Material went into the report just as it was submitted to the personnel division in order that each plant's individual concept of the problem might be exposed for the other plants' enlightenment.

Twelve plants are represented in the report, some reporting but a single idea or theme upon which its safety campaign had been carried, others a long list of individual projects going to make up the safety drive. Some plants, feeling they had found nothing particularly outstanding in 1938, contributed nothing. While details differed in almost every instance, all contributing plants seemed agreed on one point—that the success of any safety campaign was in the hands of the plant manager, foreman, and supervisors; they had to put it over.

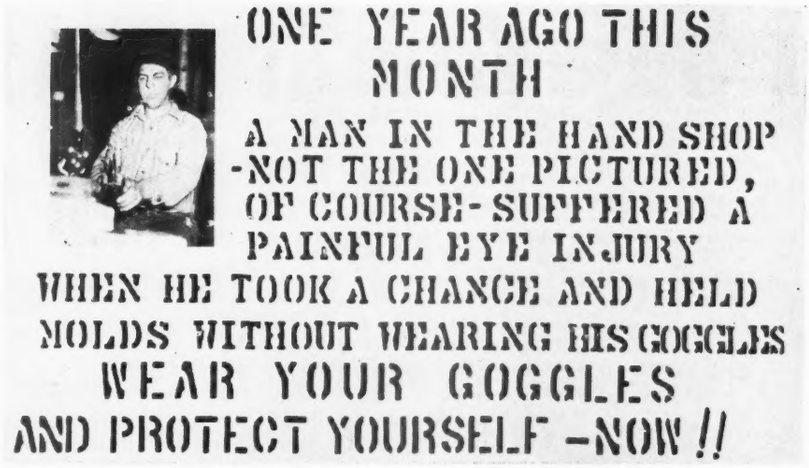
Sold the Supervisors

As the Libbey plant put it: "The biggest improvement at Libbey during the last two years has been the increased activity of the supervisors in their attention to safety ideas. Constant promotion in their direction is foremost in making a factory safe."

At Libbey, the past month's safety record is reviewed at each supervisors' meeting. Causes and costs are gone into and corrective measures devised. Glassboro has regular monthly safety meetings of department heads, minutes of which are sent to the plant manager and all supervisors. Also, bulletins are sent out to department heads, describing all accidents and giving the figures for time and wages lost. Oakland sent a safety letter to department heads each week, describing accidents or near accidents, and department heads read this letter to foremen at their meetings.

Foremen and department heads attend weekly safety meetings at the Alton plant which has probably had the most comprehensive safety campaign of all the plants. At each meeting mimeographed sheets carrying a safety thought

(Continued on page 110)


ONE YEAR AGO THIS MONTH
A MAN IN THE HAND SHOP -NOT THE ONE PICTURED, OF COURSE- SUFFERED A PAINFUL EYE INJURY
WHEN HE TOOK A CHANCE AND HELD MOLDS WITHOUT WEARING HIS GOGGLES
WEAR YOUR GOGGLES AND PROTECT YOURSELF -NOW !!

Posters, made easily and inexpensively with stencils and photographs, helped Chicago Heights sell safety and impress on employees the need for using protective equipment

THIS CROSS
WILL MARK THE SPOT WHERE LOST TIME ACCIDENTS OCCUR
DON'T MAR OUR PLANT WITH THIS CROSS AND YOU WILL NOT DECORATE A CEMETERY WITH THIS ONE
JOHN DOE
WHO DIDN'T
$0/

Oakland paints crosses to mark spots where lost-time accidents occur, and explains significance of these crosses by an ominous yard display placed where all will see it

"Little Safety Sam" didn't wear his goggles and suffered an eye injury. He stands amid a pile of goggle boxes to show that he's learned his lesson, and he'll keep standing there, nursed along by the department where the accident occurred, until there's another mishap. Then he'll move to scene of the new accident, be appropriately re-bandaged

I Say You Can't Afford NOT

Wendell E. Whipp, born on a farm near Dayton, Ohio, studied at Ohio State, got a job in the advertising department of National Cash Register Company. In 1912, after seven years with National Cash where he had become sales manager of the Columbus territory, he took over management of Monarch, then a struggling little 25-man concern which reputedly had to buy even its postage stamps on credit—always a good trick if you can do it.

Monarch has grown steadily ever since. Today, with almost 600 on its payroll, biggest in the company's history and almost twice that of 1929, it is favorably known to industry as one of the largest lathe manufacturers in the country.

Located in a town of scarcely 10,000 people where it is the largest single employer, Monarch completed a new plant addition late in June. It contains an auditorium seating 500 people, which is available for employee and community organizations, also a cafeteria and employees' lounge room

to Replace Old Equipment

Figures reveal the high cost of hanging onto obsolete machine tools. Same figures apply to other types of industrial equipment where it isn't quite so easy to measure the results

WENDELL E. WHIPP

President, Monarch Machine Tool Company
Sidney, Ohio
President, National Machine Tool Builders Association

YEARS AGO ON THE FARM, when we needed some extra help for our spring plowing, we used to hire "a man and a team." Today it might more probably be a "man and a tractor." But my guess is that the basis of hiring remains the same to this day.

When we hired a "man and a team," we didn't agree to pay so much to the man and so much for the team. We hired a "man and a team" as a unit. Obviously, neither was of any use to us without the other. Together they were worth about $5 a day.

But in return for the $5 a day we wanted not only a good man but also a good team. Would we have hired a man who showed up with a team consisting of a blind mule and a lame horse? Most certainly not. No matter how good the man might be, we knew perfectly well that with a poor team he could only turn out about half the work that was expected of him. We wanted a production unit that could do a good day's work. And that meant that the team as well as the man had to be up to par.

Blind Mule, Lame Horse

Yet right today thousands of manufacturers are trying to get their plowing done with production units consisting of good men and broken-down teams.

A first-class machine tool operator working on an obsolete and half worn-out machine tool corresponds exactly to a good farm hand trying to plow with a blind mule and a lame horse.

The best farm hand in the world can plow only half the acreage he ought to if his team is no good. The best machine tool operator in the world can turn out only half the production he ought to if the machine he works on is poor.

Metaphorically speaking, most of the machine tools in the plants of this country that are ten or more years old are "blind and lame" by comparison with the machine tools that can be had for the buying today.

Understand, I do not for a moment make the claim that simply because a machine tool is old it is no good. In many cases the old machine tools are perfectly capable of doing the particular job assigned to them. It all depends upon the type of work that has to be done, and the volume and rate of production that is desired.

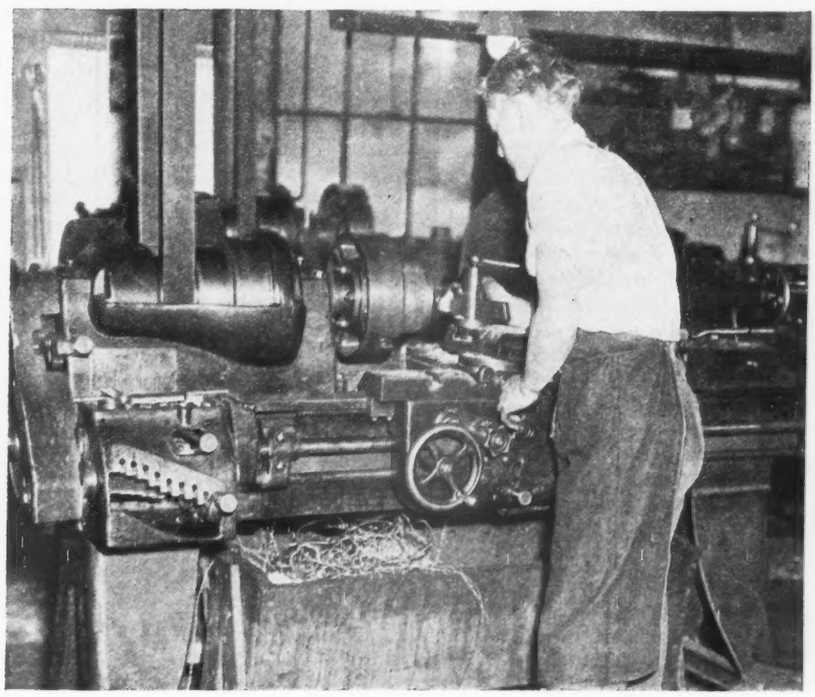
But by and large I think it has been amply demonstrated that the modern machine tool of today has just about doubled the production capacity of the machine tools of ten to fifteen years ago —not to mention further advantages having to do with accuracy and quality of product produced.

I think most manufacturers will admit this fact. Yet time and again when you talk to a manufacturer about replacement he says: "I know perfectly well that, by comparison with new models, my old machines are cripples, but I simply can't afford to replace the old machines at this time."

The actual fact is that this manufacturer cannot afford *not* to replace his old machines. And I think this premise can be simply and clearly demonstrated by thinking of machine tools in exactly the same way that the farmer thinks of

MAN PLUS OLD MACHINE

Costs $207.50 to carry the old machine for a year. But $1,750 (same as for the new machine) to run it. Total, $1,957.50. Divide by 250 (number of days worked). Then "man plus old machine" costs $7.83 per day. At 5 per cent the net profit is 39 cents per day. Now turn the page and look at the figures for the "man plus machine"



a "man and a team" at plowing time.

Suppose we consider the "man and a team" as a production unit.

A "man and a team" used to cost the farmer $5 a day. How much does a "man and machine" cost the manufacturer per day?

First, let's see how this would work out with respect to a new machine tool.

Suppose this new machine tool cost $3,000. At 5 per cent, interest on this invested capital would amount to $150 a year.

Suppose we allow $50 a year for repairs and maintenance—which would be improbable with a new machine but belongs in our calculations just as a safety factor.

With research and invention moving at such a rapid pace today, suppose, just for safety, we figure that this new machine tool should be replaced within eight years and therefore should be written off at the rate of 12½ per cent a year. This would make a depreciation allowance of $375.

These three items total $575 as the cost of carrying the new machine tool for one year.

Now let's take the man operating the machine. To be conservative, let's say he works only 250 days a year and actually operates the machine seven hours a day. This makes 1,750 man-machine hours during the year. Suppose he gets $1 an hour. That makes $1.750. Add to this the $575 to carry the machine, and you find that that production unit—man and machine—has cost $2,325 per year. Divide that by the 250 working days allowed for, and you find that the "man and machine" cost the manufacturer $9.30 per day.

With the Old Machine

That is on the basis of a new, modern machine. Now let's see how it works out for a machine that is, let us say, ten years old.

The probability is that this old machine cost only about half of what the new machine would cost. Suppose it cost $1,500. Probably the last 10 per cent still remains to be written off on this old machine, so depreciation would amount to $150. Annual interest on one-tenth of the original investment (the balance having been recovered, theoretically at least, by depreciation allowances) would amount to $7.50. Certainly with an old machine we must allow at least $50 for repairs and maintenance. This makes $207.50 as the cost of carrying this old machine for one year as compared with $575 for the new machine.

Now we come to the other side of the story. The man operating the old machine has to be paid just as much as he does to operate the new machine. On the same hours and days basis used in the preceding illustration, he would still cost $1,750 a year. Add the $207.50 for the carrying cost of the old machine, and we get a total of $1,957.50 per year as the cost of this "man and machine" to the manufacturer. Dividing this by 250 (the number of days worked a year), we find that the man and the old machine cost $7.83 per day.

In short, the "man and old machine" cost the manufacturer only $1.47 a day less than the "man and new machine" would cost.

Now—how about productivity?

As I have said before, it has been shown in many cases that the productivity of modern machines is just about twice that of the machines of ten to fifteen years ago.

The final measurement of productivity is profit. How much money does the manufacturer make on the "man plus old machine"?

These are days of narrow profit margins. After taking into consideration taxes, overhead, sales expense, and all the rest, a net profit of 5 per cent is often fortunate.

So let us say that on the "man plus old machine" production unit, the manufacturer is making a net profit of 39 cents a day. In other words, for his $7.83 he gets back $8.22.

Now—how would he come out with a new machine?

For purposes of illustration let us suppose that the new machine exactly doubles productivity. That is, the "man plus new machine" turns out just twice as much as the "man plus old machine."

Since the output of the "man plus old machine" brings in $8.22 per day, the output of the "man plus new machine," being doubled, would bring in $16.44.

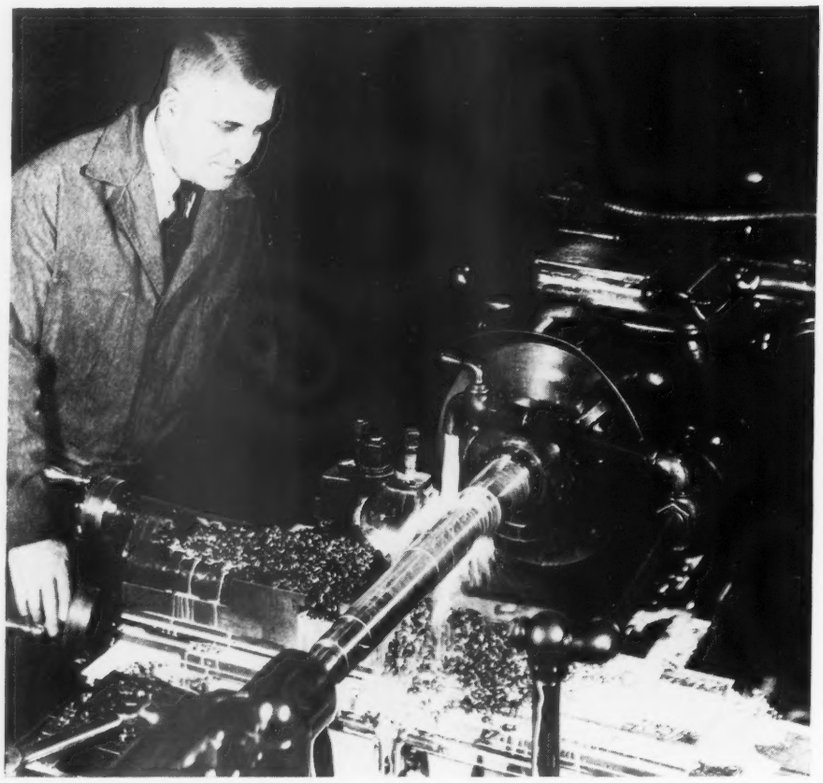
But what is the cost of the "man plus new machine"? That has already been established at $9.30 per day. This leaves a net profit of $7.14 a day.

Remember we assumed that the profit of 39 cents a day realized on the "man plus old machine" was net—after taxes, overhead, sales expense, etc. The figures on the "man plus new machine" are

(Continued on page 106)

MAN PLUS NEW MACHINE

Cost more ($575) to carry the new machine. But no more ($1,750) to run it. Dividing total ($2,325) by 250, "man plus new machine" costs $9.30 per day. But the output of "man plus old machine" was $8.22 ($7.83 plus $0.39), whereas the new machine turns out twice as much ($16.44). Net profit ($16.44 less $9.30) is $7.14 as against 39 cents a day for "man plus old machine"—an increase, believe it or not, of 1,700 per cent



EMPLOYEES NEWS LETTER

THE AMERICAN ROLLING MILL COMPANY—BUTLER, PENNSYLVANIA

TO: ARMCO MEN AND WOMEN
BUTLER DIVISION

April 6, 1939

This is the first issue of what we hope will be an interesting and worthwhile service letter to Butler ARMCO Employees. Purpose of these letters is to keep you informed about what is going on in the steel industry as a whole, ARMCO in particular. News affecting steel consumption, production, distribution or other factors influencing our job as steel workers and as ARMCO employees will be "boiled down" and written for easy, understandable reading.

Tell Employees by News Letter

Nothing fancy. A mimeographed page or two. But for all that an effective way to keep employees in the know

HUGH W. WRIGHT
Assistant to Director of Personal Relations
The American Rolling Mill Company, Middletown, Ohio

TO THE MEASURES for building friendly relations and better understanding between management and employees, add the employees' news letter. About a year ago we began publishing a weekly service letter, filled with brief factual items about conditions affecting our people's jobs.

These letters are distributed when the men receive their pay checks. Previous efforts at keeping employees informed, carried on for some 30 years, usually resulted in reaching only certain groups. Because it is about the job and affects their pay checks, this does a thorough job of reaching all employees. You would be surprised how many are taken home for the wife to read. We avoid writing editorials or making statements of opinion. As a result, every week we hear many expressions of appreciation from the men.

Cost Is Small

Any company could start issuing a letter of this type at any time. It costs very little; it does not conflict with the plant newspaper. In fact, it does a better and more timely job of getting serious information about the business to the employee, for in the plant paper serious articles must attempt to compete for attention with pictures and "human interest" material. You know which type wins. In the light of all the talk we have heard in recent years about keeping employees informed, the news letter as a practical tool seems to have been overlooked. Our experience proves it to be practical and effective.

To show the type of news presented in these letters, and the way we introduced the idea to our people, I am going to give below the content of the first letter published at our Butler plant. This letter was dated April 6, 1939, the Butler Division introducing the letter at a later date than the Ashland and Middletown divisions.

"This is the first issue of what we hope will be an interesting and worthwhile service letter to Butler ARMCO employees. Purpose of these letters is to keep you informed about what is going on in the steel industry as a whole, ARMCO in particular. News affecting steel consumption, production, distribution, or other factors influencing our job as steel workers and as ARMCO employees will be 'boiled down' and written for easy reading.

"Charles R. Hook, ARMCO president, long ago said: 'Take the mystery out of business.' What affects business affects you, your job, your family. These letters should keep us informed.

"*How's the steel industry doing?* The approximate national average of ingot production for March was 55.6 per cent compared with 33.85 per cent in March 1938. Hourly men at Butler averaged 36.2 hours a week during March this year. Average for March 1938 was 22.1 hours' work per week.

"*The European map* is changing rapidly and day-to-day developments abroad are bewildering and cloud the future. One Washington commentator who 'gets around' says there is a fifty-fifty chance of a European war this year. But over here we expect springtime will mean Easter bonnets and new automobiles.

"*Automobile production,* although far above last year's output for this period, registered a drop last week, attributed partly to unseasonable weather which affected auto sales. Our source states the first quarter's production of cars and trucks will be close to 1,100,000 units. The automobile industry, one of our good customers, plays a big part in our sales, and we are all interested in watching the trend of auto production.

"*Stainless.* Biggest single week for a long time in orders for ARMCO Stainless occurred in March, resulting in a

(Continued on page 106)

THE ABCs of PERSONNEL

Be patient and punctual. But if you harbor traits of obstinacy, ordinariness, and perfidy, you'll do well to be rid of them. Next month, Q's and R's

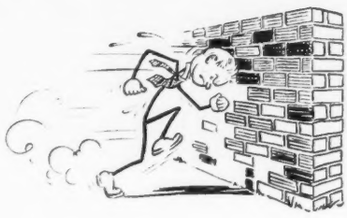
CHARLES S. STEVENSON

General Manager, Hall Brothers, Inc., Kansas City, Mo.

SKETCHES BY ORIN W. LOO

Obstinacy

"That shop department head of ours is a willful old rascal," said the plant treasurer to the president. "He won't admit that my strategy in working out the McKinley deal was better than his on the Johnson job. He's an obstinate cuss!" The executive chuckled. "My old psychology teacher at college used to talk to us frequently about obstinacy. He used only three phrases . . . I'll write them for you . . . you'll profit by his philosophy." Here's what he wrote: It's *obstinacy* in an employee—it's *firmness* in a department head—it's *determination* in a boss . . . "Of course, he was just joking," the president went on. "but a lot of folks get tripped up just because they haven't figured out *who's who* or *what's what* in the *right place* at the *right time*."



Ordinariness

The art director of a large advertising agency was turning down an applicant for its designing department. "These sketches, Miss Ross," he commented, "are not bad at all—as a matter of fact, they are much better than I personally could do, but unfortunately they are no better than any average artist can do. When I say they are just ordinary, I say so in relation to other artists' work. Naturally our interest is in getting the best." Whether he knew it or not, this executive was appraising charcoal and pencil sketches exactly as personnel men and women appraise jobs. The difference between an *ordinary* job and a good job is merely the difference between *ordinary* effort and *extra*ordinary effort.

Patience

The trainer of circus fleas attributes results in his chosen field to *patience* . . . the master of the canvas counsels *patience* to beginners . . . successful salesmen reveal *patience* to be as necessary to success as personality . . . requisites of personnel directors and counselors are *patience*—and then *more patience*. In medicine, law, music, industry—no field of human endeavor can parade its triumphs without the shadow of someone's patience in the background. "He's got the patience of Job," is about as high a tribute as can be paid to an individual. This trait is one of the cardinal virtues of all mankind . . . if anyone doubts it, let him refer the matter to his mother, his teachers, his wife, and his boss.

Perfidy

Dishonesty . . . fraud . . . lying . . . treachery . . . unfairness . . . disloyalty . . . treason . . . villainy . . . knavery . . . corruption . . . betrayal . . . deception . . . cheating . . . stealing . . . swindling . . . misrepresentation . . . hypocrisy—seventeen bad-looking words, any one of which as a personal trait will offset any powerhouse combination of all the desirable characteristics. Good looks, poise, mental alertness, enthusiasm, and even ability will not be enough to overcome the handicap of the mildest of these vicious terms. Beware of even a fleeting acquaintance with any of these seventeen synonyms for *perfidy*.

Punctuality

"The girl friend" attempting to intrigue "the boy friend" may let him sit in the living room while she takes 30 minutes to put on the finishing enticing touches, but her boss, with different interests, can hardly be expected to be quite as patient as she rushes late to her desk the next morning. Punctuality is one of those paradoxical traits . . . you won't get promoted if you have it, but you might lose your job if you don't have it. It is far more appreciated by management than most folks would ever believe . . . and yet it's not in the lists of *musts* for success . . . *it costs nothing to be punctual and it really gives a comfortable, self-assured feeling.*

Why and How We Train Apprentices

Hyatt's training program keeps it rich in skilled men year in and year out, and fosters good company-community relations by giving young men a chance to learn a trade

FRANK R. WODTKE

Director of Apprentice Training
Hyatt Bearings Division, General Motors Corporation, Harrison, N. J.

TWENTY-TWO CONSECUTIVE YEARS of apprenticeship training qualifies Hyatt as one of the pioneers in this phase of educational work. Underlying our present program are the principles that our abundant experience has taught us are the basis of such a program. By outlining our present course of instruction I hope to pass on to other companies planning (or already using) such programs what our 22 years have taught us.

The object of this course is two-fold: First, to permit ambitious young men to learn a trade and become a credit to our community, and to develop desirable candidates for good citizenship; second, to guard the quality of our product by having available at all times an organization of skilled toolmakers and machinists, to select from their ranks likely candidates for positions of technical or executive responsibility. In addition, we do our part to replenish the supply of skilled mechanics annually removed by death and old age.

Frank Wodtke (shown above with one of his classes) is no neophyte apprentice trainer, for right after graduating from Pratt Institute's mechanical engineering course he became an instructor in Yale & Towne's apprentice school. Since then he has been back to Pratt to teach for a year, and during 1938-39 he has been teaching evening classes at the Paterson (N. J.) YMCA in addition to his classes at Hyatt, where he's been since 1930. In between his teaching assignments he's served in supervisory and engineering capacities at Mack Truck, Marmon Motor Car, Mergenthaler, and Curtiss Aeroplane

An applicant must be at least 16 and not more than 21 years of age. He must have had at least a grammar school education, a sufficient degree of physical development, and possess the essential qualifications for the effective pursuit of the training he desires.

The candidate must pass a competitive examination, which indicates the manner in which he has applied himself in school and whether or not he can meet our requirements as a student and graduate.

Greater importance is attached to the definiteness of purpose, general fitness, and character of the candidate, rather than to his previous academic accomplishments.

All other conditions being equal, preference is given to relatives of employees. All candidates are personally sponsored by some well-established employee.

The rates of pay vary, but range from 31 per cent at starting to 81 per cent of our first-class machinists' basic rate. Increases are given after completing each period of 1,200 training hours.

An accepted candidate must serve a trial period of 600 hours, which is included in his total of 7,200 training hours. During that time the following characteristics are carefully observed: Capacity to follow instructions; ability to absorb knowledge; reliability;

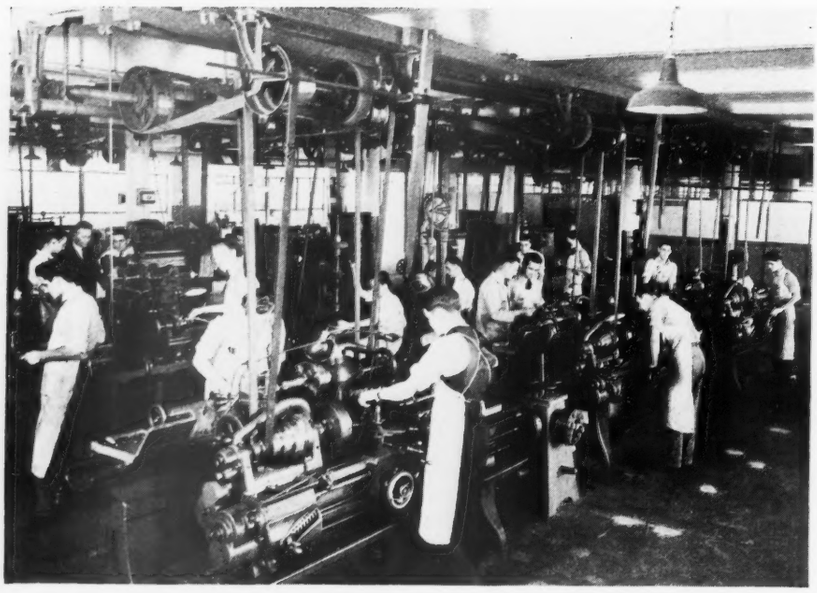
craftsmanship; effort and attitude toward his work, his co-workers, and the company.

If the student has shown suitable proficiency in the trial period and expressed a desire to continue, he is allowed to sign an "Agreement of Apprenticeship." In accordance with this agreement, the student deposits $25 as a "symbol of good faith," which will be forfeited if the apprentice resigns or is discharged before the expiration of his contract. This sum is returned with interest added, however, upon the satisfactory completion of the whole term of apprenticeship.

Good Tools to Work With

Progress during the course depends upon good working tools. The apprentice is encouraged to provide himself with ordinary tools, such as scales and calipers, as need arises during the training period.

The apprentice school is liberally provided with facilities for instruction and is under the direct supervision of a qualified instructor and assistant, who give their entire time to it. A special department is provided to train the first-year students. The equipment, carefully selected and properly related to the various subjects of instruction, is frequently improved upon. A classroom is located adjacent to the machine shop, where provision is made to teach the necessary technical subjects.



In the machine shop apprentices learn by doing, working at both machines and benches

TOOL AND MACHINE TECHNOLOGY

First Year

Shop Terms	Shapers
Measuring Instruments	Functions of Numbers
Geometric Construction	Mathematical Symbols
Drafting Data	Mensuration Rules
U. S. Form Threads	Algebra
Hack Saws	Slide Rule
Drills	Right Triangles
Hendey Lathes	Taper Pin Reamers
Cutting Tools for Hyatt Materials	Tapers
Plain Indexing	Briggs Pipe Threads
Keyways	

Second Year

Graphic Logarithms	Grinding
Acme Threads	Dovetails
Differential Indexing	Gearing
Spiral Milling	Sine Bars
Pulleys and Belts	Weight Calculations
Diameter Chords and Arcs	Johansson Blocks
Broaching	Prestometer
Tool and Material Procedure	Vernier Height Gage
Heat-Treating Nomenclature	Punch and Die Allowance
Rockwell Testing Machine	

Third Year

Mechanics	Oblique Triangles
Cam Milling	Mechanics of Heat
Strength of Materials	Electricity
Horsepower	Metallurgy

Contents of the textbook used give a good idea of what the three-year course includes

The three-year course consists of three units of 2,400 hours each. The first year is devoted to intensive instruction in toolmaking and fundamental machine operations. Tool orders, specially selected for instructive purposes on lathes, millers, shapers, and grinders, are introduced to the untrained boy, and the finished tools are used in the current tool and machine production. Nothing better arouses the student's interest than the realization that his personal accomplishments contribute to the necessary tools for making our product.

Second- and third-year students are transferred to the toolroom, machine shop, and drafting room. After deriving the benefit of the fundamental instruction given during the first year, added experience will be gained by working on more advanced problems and in the environment of our journeymen, toolmakers, and machinists.

Progress Is Charted

A chart is made of each student's record. It indicates the plan and the progress of the student, which is used as a permanent record. It is used also by the apprentice supervisor as a guide for personnel changes, which are relayed for the consideration of the respective foremen at the required interval of time.

Four hundred hours are allowed for classroom instruction. One hour a week for all three years the apprentice spends in a mathematics class. Three hours a week are devoted to drafting throughout the first and second years. Once a month he attends a safety meet-

(Continued on page 116)

Motion Study Research

4(a). A Study of Simultaneous, Symmetrical Hand Motions

Fundamental data on the motions a worker makes when he reaches across the workplace for material to bring it toward him to assemble, inspect, or perform an operation

RALPH M. BARNES and MARVIN E. MUNDEL

Professor of Industrial Engineering and Research Assistant in Mechanical Engineering
University of Iowa

OFTENTIMES the over-all effectiveness of the worker may be improved by arranging his workplace so that he can perform, with both hands in a simultaneous symmetrical fashion, the therbligs of which the task consists.

Part A of this research was therefore undertaken to evaluate the effect of the angle which the motion paths of the operator's hands make with the plane of the front of the worker's body upon the efficiency with which the worker moves his hands away from and towards his body in a simultaneous, symmetrical fashion, *when only the terminal points of the motions were fixed by the workplace*, the operator directing his hands between them along a convenient path. Such movements as these are made when the worker reaches across the workplace for material to bring it

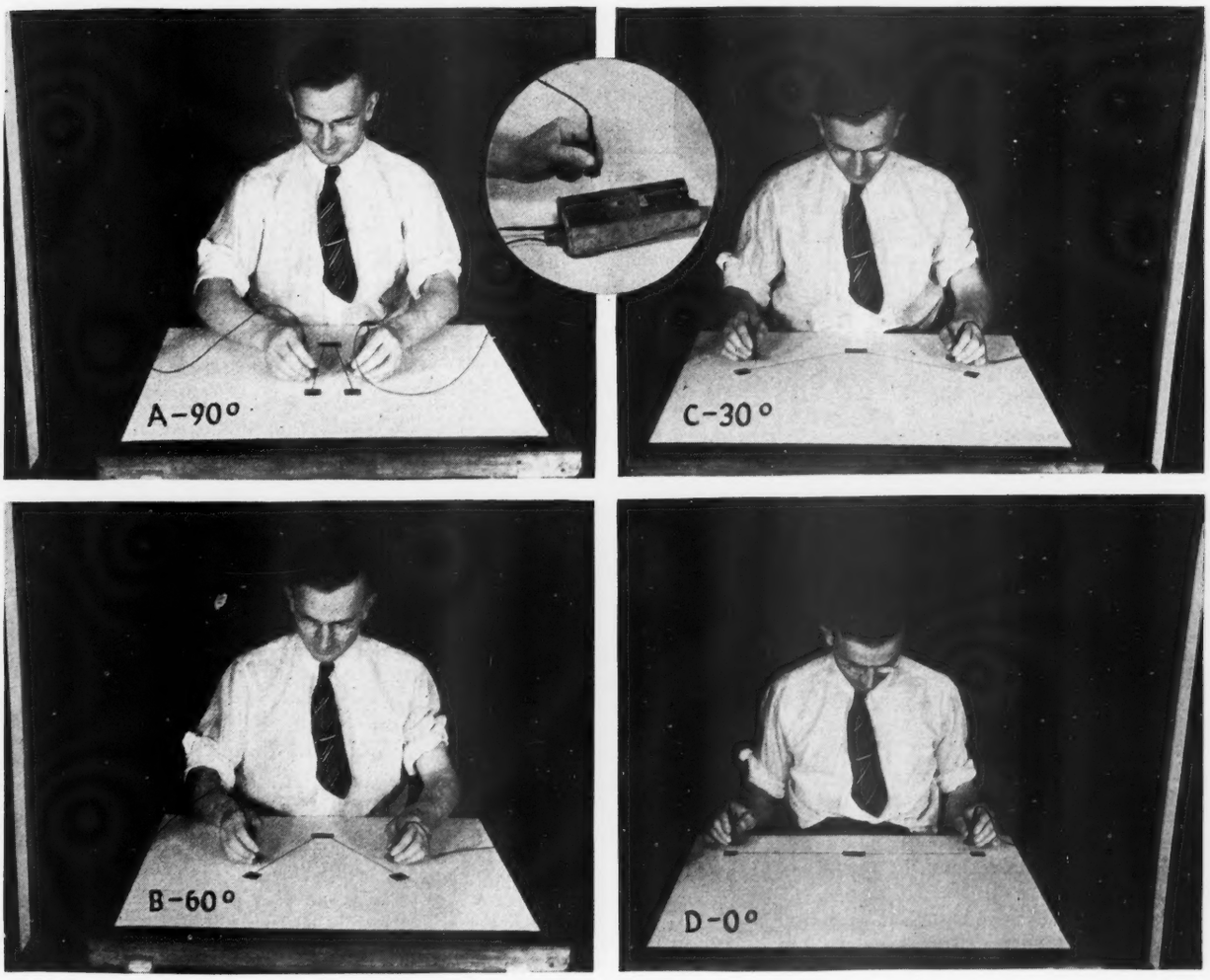


Figure 1. Four views of the pursuit board used in the study, showing an arrangement of the workplace when only the terminal points of the motions were fixed. The angle that the motion path of each hand made with the plane of the front of the operator's body is shown in each of the four photographs. In circle, a close-up of operator inserting electrode into the hole in an uncovered unit

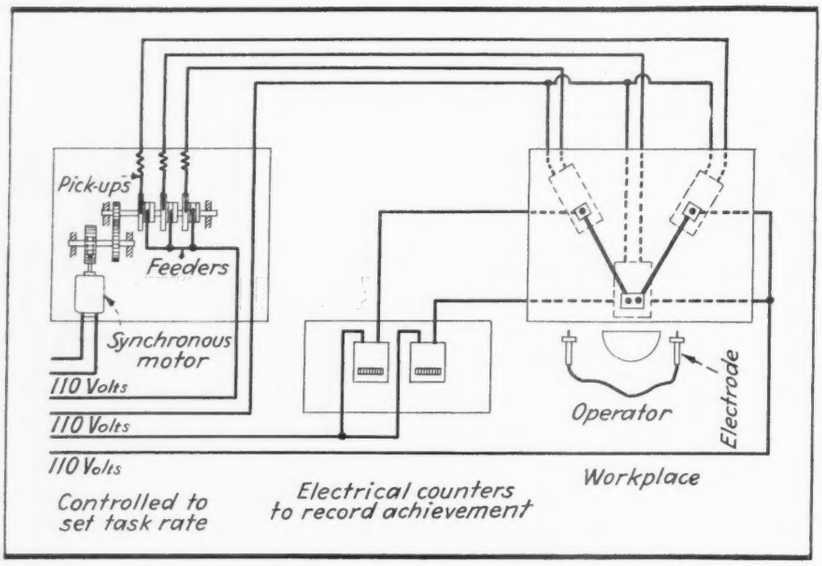


Figure 2. Wiring diagram of pursuit board and auxiliary equipment used in this study

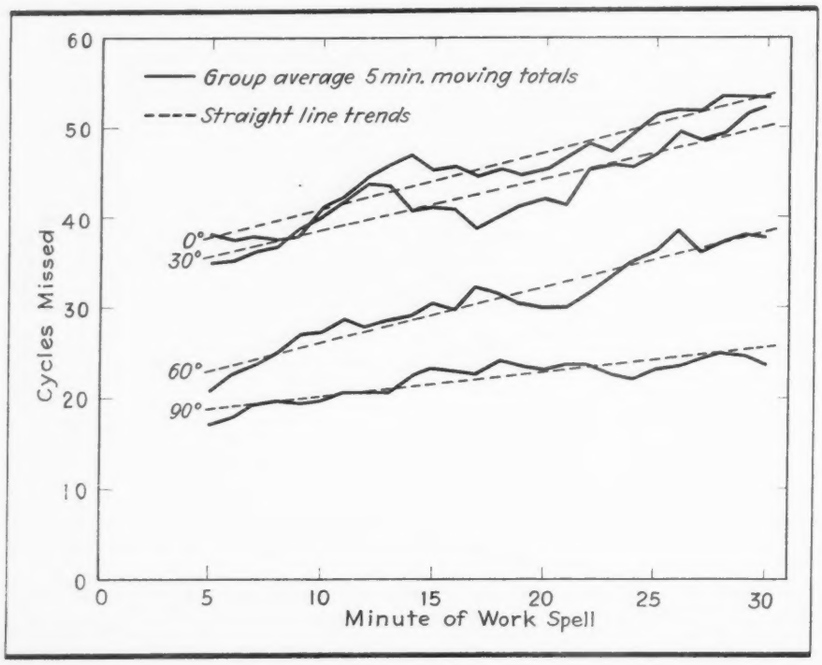


Figure 3. Group average of 5-min. moving totals of number of cycles missed during the last four work spells. Angle that path of each hand made with plane of front of operator's body is indicated on the curves. The straight line trends indicated are those lines about which the sums of the squares of the deviations of the points of the 5-min. moving totals are at a minimum. Here only the terminal points of motions were fixed

toward him to assemble, to inspect, or to perform some operation upon it.

Equipment Used — In studying the motions where only the terminal points were fixed by the workplace, the hands repeatedly performed a cycle which for each hand consisted of two *use* therbligs and a *transport loaded*. The actual task consisted of sitting at a table (Figure 1) and simultaneously carrying an electrode with each hand back and forth between points on the workplace. The electrodes were made up of copper rod 1/16 inch in diameter set in a convenient wooden holder. The points on the workplace were located symmetrically for the two hands, and the operator inserted the electrodes simultaneously into 3/8-in. holes in the metal plates on the workplace surface at these terminal points.

The electrodes could be inserted into the holes only when a metal shield covering their underside was drawn back, this being done electrically to set a definite task rate for the operator to attempt to maintain, and to prevent the production over a given work spell from being merely a reflection of the particular mood of the operator. Symmetrically located holes opened and closed together.

When the electrodes were inserted into a hole, they made contact with copper plates 1/4 inch below the upper surface of the holes. The two electrodes were connected to the ends of a soft, flexible wire. When the electrodes were both touching their respective contact plates at the bottoms of a pair of symmetrically located holes, they completed the circuit, connecting these two contact plates with an electrical counter which recorded the insertion.

It is to be noted that this circuit arrangement, as shown in Figure 2, which is a wiring diagram of the set-up for this phase of the experiment, necessitated the two electrodes being in contact with a pair of symmetrically located contact plates simultaneously. However, this did not require that the touching of the contact plates with the electrodes begin or end simultaneously. The time each hole was open was four-tenths of a second, this being somewhat longer than the actual time required to insert the electrode. This gave the operator some leeway in the performance of the task. To keep the required task constant, the device used to close and open the circuits that opened and closed the holes was driven by a synchronous motor.

Constant Conditions

The maximum number of insertions was 40 sets of two insertions with each hand—that is, 40 sets of four insertions per minute, pairs of insertions being made simultaneously with the two hands. The insertion was used as a terminal therblig in place of the *grasp*, or *position* and *assemble*, or *hold* which usually follows a *transport*, since the conditions surrounding the insertion or *use* could be kept absolutely constant and the effect of changing the angle made by the motion paths could be evaluated by itself.

With the electrical counters recording the number of pairs of insertions made, and with the number of insertions recorded each minute of the work spell, the number of cycles missed could be determined for each minute of the work. Since the maximum number of cycles that could be performed was always 1,200 per half hour, the number of cycles missed was in inverse relationship to the production, and a small number of misses indicated a large production. The number of cycles missed was used in preference to the number of

Few are the plants that don't have scores of assembly and inspection operations—or maybe just plain "jobs"—that employ the fundamental hand motions analyzed by Professor Barnes and Mr. Mundel; their findings will therefore hit industry's methods men "where they live"

cycles completed because in all cases this was a smaller figure and provided simpler data.

The four different arrangements of the workplace are shown in Figure 1—*A*, where the paths of the two hands each made an angle of approximately 90 degrees with the plane of the front of the operator's body; *B*, where they each make an angle of 60 degrees; *C*, where they each make an angle of 30 degrees; and *D*, where they each make an angle of 0 degrees, all with the same reference plane. The distance between the two terminal points for each hand was always 10 inches, measured between the centers of the holes into which the electrode was inserted.

Procedure—Previous to working, the operators were given the following instructions and explanation:

"Now each time you work at this, before we start the actual work spell for which we will take data, you will be given a minute of practice, then a minute of rest, and then a minute warm-up followed without any pause by the half-hour work spell for which data will be taken. The task rate will always be the same, but from work spell to work spell we shall vary the physical pattern of the movements that are required."

The operators all worked for twelve half-hour work spells, the order of the different physical conditions of work being the same for all operators and was as follows: 90, 60, 30, 0, 0, 30, 60, 90, 90, 60, 30, 0—the number in each case representing the angle (in degrees) that the motion path of each hand made with the plane of the front of the operator's body.

TABLE I SUMMARY RESULT SHEET

Only terminal points of motions fixed

Group average 5-min. moving totals and average totals of the number of cycles missed during work spells No. 1, 2, 3, 4, 9, 10, 11, and 12. (Based on ten operators)

5-min. moving total placed at last minute included in total

Minute of Work Spell	*Number of Work Spell* 1	2	3	4	9	10	11	12
5	50.1	49.9	62.3	58.4	17.1	20.7	35.0	38.2
6	52.0	51.7	64.8	60.0	18.0	22.7	35.2	37.6
7	55.1	56.3	62.2	62.3	19.5	23.8	36.3	38.0
8	56.5	57.4	61.6	64.2	19.7	25.0	36.8	37.7
9	55.9	57.7	61.0	66.2	19.5	27.1	38.8	38.0
10	55.9	58.6	60.2	66.5	19.8	27.3	40.1	41.4
11	53.6	57.8	60.3	68.6	20.7	28.8	41.8	42.4
12	52.0	54.6	64.0	68.4	20.6	28.0	43.9	44.5
13	50.5	54.0	66.5	69.1	20.7	28.7	43.5	45.9
14	50.5	54.3	68.0	67.3	22.5	29.1	41.0	47.0
15	52.4	53.0	68.8	67.8	23.4	30.5	41.2	45.4
16	53.2	54.2	67.4	66.3	23.2	29.9	41.0	45.7
17	53.0	56.9	68.5	65.7	22.8	32.4	38.8	44.7
18	55.1	59.1	69.0	66.6	24.1	31.6	40.1	45.5
19	53.9	59.1	69.6	67.7	23.6	30.4	41.4	44.7
20	53.8	61.1	69.6	68.1	23.3	30.0	42.0	45.2
21	55.3	61.6	71.2	70.3	23.8	30.0	41.4	46.7
22	55.3	64.3	69.2	71.2	23.8	31.6	45.2	48.2
23	55.1	66.9	68.2	69.1	22.7	33.5	45.9	47.4
24	58.5	69.0	68.4	71.6	22.1	35.2	45.7	49.5
25	56.6	69.7	69.5	72.2	23.3	36.4	47.0	51.4
26	57.5	69.4	68.8	71.4	23.6	38.7	49.7	51.9
27	57.2	67.3	70.0	71.9	24.5	36.4	48.5	51.9
28	56.7	65.5	70.3	72.6	25.0	37.4	49.1	53.5
29	55.1	64.0	70.7	70.8	24.9	38.0	51.5	53.4
30	56.4	63.5	71.0	72.8	23.7	37.9	52.1	53.4
Average total number of cycles missed	*325.2*	*355.8*	*401.4*	*405.8*	*130.6*	*182.8*	*257.4*	*275.0*

Four Work Spells a Week

No operator worked more than one work spell per day, and each worked four work spells per week. The operator always worked at the same time of day, and no tests were run when an operator was tired or stiff from other activities. The ten operators were all male college students.

Results—The group average 5-min. moving totals of the number of cycles missed during work spells No. 1, 2, 3, and 4, and No. 9, 10, 11, and 12, which are the first four and the last four work spells respectively, and the average total number of cycles missed, are given in Table I.

The straight line trends fitted to the group average moving totals of the eight work spells are given in Table II. These straight line trends have been fitted to the moving totals by the method of least squares, and are those straight lines about which the sum of the squares of the deviations of the original points are at a minimum. The group average 5-min. moving totals actually represent the data taken, but these straight lines are the "best estimate" of the trend that may be deduced from the data and expressed in simple form.

The group average 5-min. moving totals of the number of cycles missed during work spells No. 9, 10, 11, and 12, and the straight-line trends fitted to these moving totals are presented graphically in Figure 3. The straight-line trends were fitted to give, in a simple form, the "best possible estimate"

of the rate of increase in the number of cycles missed per minute, or an index of the fatigue rate, which in this case is the co-efficient of X in the straight line equation given in Table II.

It is to be noted that the first eight work spells were given as practice, although the operators were not told this.

Conclusions—These conclusions apply to the operators studied in this experiment and for the 10-in. movements made simultaneously and symmetrically under the working conditions of this study.

1. When the motion of the paths of the hands made an angle of 90 degrees with the plane of the front of the body, the operators tended to miss at least 29 per cent less cycles than at any other angle.

It is also to be noted that this was the trend for all the operators; the average value used is not a "fictitious average," but a good representation of the "typical" case. (Since the maximum number of cycles that could be performed was always 1,200 per half-hour, the fewer cycles missed, the greater the production.)

If we consider the total number of cycles missed during a work spell, and if we take as 100 per cent the average number of cycles missed during work spell No. 12 (0 degrees), we note that the operators averaged only 93 per cent of this number of misses when the angle involved was 30 degrees, only 66 per cent as many when the angle was 60 degrees, and only 48 per cent as many when the angle concerned was 90 degrees.

However, the operators, in reference to the last four work spells, first worked with the 90-deg. angle, then with the 60-deg. angle, then with the 30-deg. angle, and finally with the 0-deg. angle, so that if there were any additional learning or increase of skill of the operators during these last four work spells, the obtained differences of the average total number of cycles missed are too small rather than too large, and the 90-deg. angle is *at least* as superior to the others as indicated.

2. When the motion paths of the hands made an angle of 90 degrees, with the plane of the front of the body, the operators showed a fatigue rate at least 39 per cent lower than at any other angle.

The slope of the fitted straight line in each of the last three work spells is greater than that for work spell No. 9, where the paths of the hands made an angle of 90 degrees with the plane of the front of the operator's body. However, of the four slopes of the straight lines fitted to the group average 5-min. moving totals of the number of cycles missed during the last four work spells, three of them are higher than the slope of the fitted straight line for the corresponding work spell of the first four work spells. See Table II.

This indicates that the learning or increase of proficiency, denoted by the decrease in the total number of cycles missed, tends in this case to increase the rate of fatigue, probably because in the later work spells of the experimental series the operator became able to exert himself more by being able to avoid the frequent waits occasioned by misses. That is to say, if any additional learning other than that gained during the first eight work spells was gained during the last four work spells, the difference between the fatigue rates for the 90-deg. work spell and the other three arrangements as inferred from the last four work spells is maximized.

TABLE II

Only terminal points of motions fixed

Equations of straight line trends for the first four and for the last four work spells. The straight lines are those about which the sums of the squares of the deviations of the points on the group average 5-min. moving totals, to which they were fitted, are at a minimum

The units of Y are cycles missed
The units of X are minutes of work spell

Number of Work Spell	*Angle Which Paths of Hands Made with Plane of Front of Operator's Body*	*Equation of Straight Line*	*Fatigue Index**
1	90	$Y = 51.5 + .170X$	.170
2	60	$Y = 48.8 + .633X$	.633
3	30	$Y = 60.0 + .398X$	.398
4	0	$Y = 60.6 + .423X$	.423
9	90	$Y = 17.8 + .250X$	.250
10	60	$Y = 20.1 + .612X$	.612
11	30	$Y = 32.8 + .574X$	.574
12	0	$Y = 34.6 + .638X$	.638

* The fatigue index is the slope of the straight line. This is the rate of increase of Y in relation to X and is the increase in the number of cycles missed per minute, per minute of the work spell. Defining fatigue as a decrease in output due to previous work this index is a measure of the fatigue of the operator at the different tasks

Lower Fatigue Rate

However, the fatigue rate for the last work spell where the paths of the hands made an angle of 90 degrees with the plane of the front of the operator's bodies (work spell No. 9), is still lower than the fatigue rates obtained with the other angles during work spells No. 2, 3, and 4, which took place prior to work spell No. 9.

It is to be noted that the fatigue rate for work spell No. 9 has been subjected to the maximizing effect of the considerable intervening practice, indicating that the physical arrangement of the task of work spell No. 9 is *at least* 39 per cent less fatiguing than any of the other arrangements of the workplace.

3. The foregoing suggest that when motions of the hands are made freely through space in a simultaneous, symmetrical fashion between fairly-well-fixed points on the workplace toward which the operator must *direct* his hands, the most efficient arrangement of the workplace is that which permits the operator to move both hands in the same direction, in such a way that the paths of each hand make an angle of 90 degrees with the plane of the front of his body. It is further suggested that the visual requirements of a task of this nature are the predominating factors determining the optimum conditions.

[*Part B of this study will appear in an early issue.*—Ed.]

Management Shorts

Readers are invited to contribute brief articles, illustrated when possible, reporting out-of-the-ordinary management accomplishments. Accepted articles will be paid for

Materials Handling

Street Traffic Control Applied to Plant Trucking

SOURCE

Frigidaire Division of General Motors Corporation, Dayton

Basic similarity of the traffic problems in plant trucking and in city streets is testified by the effective cure that has been developed for one set of hazards at this company's Dayton plants. In both these plants, power trucks and tractors, as well as assorted varieties of hand trucks, move in and across factory aisles.

At the larger Moraine City plant, the long and comparatively narrow building creates a heavy traffic flow of power units longitudinally, and hand-lift trucks, box trucks and the like on the shorter cross hauls. The lengthwise aisles are wide, well surfaced and ideal for rapid, efficient trucking. The cross-plant flow of traffic, on the other hand, comes from the narrower passages between machine lines, often with a bulky machine right at the edge of the main trucking aisle where the traffic is heavy. The hazard is, of course, that the hand trucker's vision is obscured, and great care is necessary to prevent confusion.

To protect them from accidents, all truck operators are trained to operate their machines and taught the traffic rules of the plant before they are allowed to drive a power unit. Experimental stop signs embedded in the floor have been replaced by large yellow signs that hang over the aisles near important intersections, and yellow floor markings which serve to remind the drivers of traffic limits. All drivers are trained to stop before entering an intersection to make sure the way is clear, just as motorists must do on city "stop" streets.

Red-and-green stop-and-go light controls trucking at crossing where vision is obscured

In the Taylor Street plant, power trucking goes on in both directions on about an equal scale. At one particular intersection where department walls obscure vision dangerously, a red-and-green stop-and-go traffic light has been set up, blinking signals at intervals determined by careful tests. Elsewhere, the same regulations apply as do in the other plant, and the same yellow signs and floor markings are in evidence.

•

Tandem Dollies Solve a Handling Problem

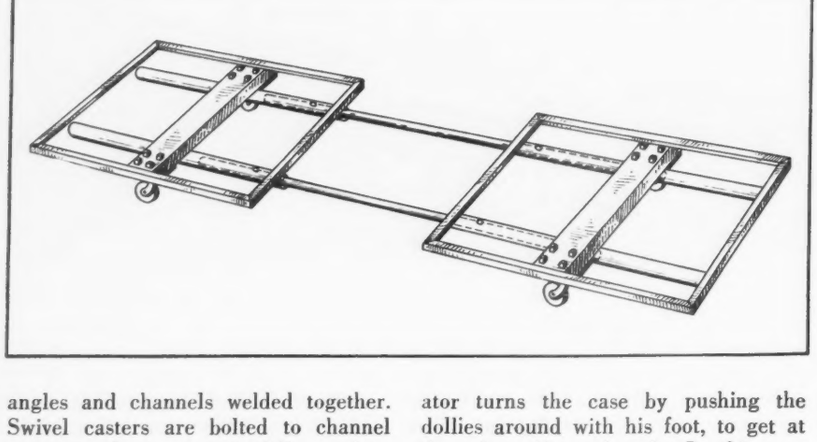
FRANK ELLWOOD, *Chicago*

Handling a large-sized steel case or cabinet through assembly and finishing operations without marring or touching freshly coated surfaces presented a difficult problem to a mid-western plant. This case, 30 in. deep, 45 in. high, and 4, 8, or 12 ft. long, has to be shifted and turned several times in the process.

After assembly has started, the unit soon becomes too heavy to handle easily. After it has been sprayed with synthetic enamel it cannot be touched without danger of producing a defect in the surface. However, the freshly coated case must be moved and turned in the spray booth, and taken to the baking oven. Quantity produced is too small and too irregular to warrant installation of a conveyor. In fact, these cases are only one of a number of different products, and are assembled on order.

In assembly, the steel angle-iron frames are first bolted and welded together; then inside parts and fixtures are placed in position, and the formed sheet-steel sides, top, and ends are assembled over the framework, and attached by self-locking bolts and nuts.

This handling problem was solved by building the assembly on two special two-caster dollies which are joined together by two adjustable spacer pipes. Dollies are 36 in. square, are made of light structural steel



angles and channels welded together. Swivel casters are bolted to channel cross members on each dolly, and to the bottom of each dolly two sections of 2-in. pipe are welded. As the case remains on the dollies in the oven the casters cannot be rubber tired.

Into these pipe sections lengths of 1¾-in. pipe or tubing fit. Since these pipes can be slid back and forth, they serve as spacers to tie the dollies together. Bolts without nuts are inserted in holes drilled through both fixed and sliding tubes to hold dollies the necessary distance apart. Two different lengths of spacers are required. The shorter length handles cases 4 or 8 ft. long, and the longer, cases 8 or 12 ft. long.

For assembly, two dollies are spaced the proper distance apart, and the case is then assembled on them. After inspection, the case is pushed or pulled into the spray booth. After spraying one side and end, the operator turns the case by pushing the dollies around with his foot, to get at the other side and end. In this way he always sprays toward the booth suction, and need not touch the case. His foot does not touch the case because the dollies are wider than the case and are spaced so that their over-all length is greater than that of the case.

After another inspection the case, still on the dollies, is pushed into the baking oven. When it is removed from the oven the case is given a final inspection and allowed to cool for crating. Because the dollies have open tops the case is easily lifted by a hoist on hooks attached to four padded cables, and set on the bottom of the crate.

Dollies may be disassembled by removing bolts and spacer pipes, and packed away. If they are to be used again shortly, they can be set on their sides along the wall where they will be out of the way.

Production Methods and Materials

Rejuvenated Welding Set-Up and Made Savings

KEITH BROWN
Lyon Metal Products, Incorporated
Aurora, Ill.

Realizing that the past few years have brought such improvements in design, capacity, and operating technique of resistance welding equipment that we might have failed to keep up with developments, we undertook to rejuvenate our welding set-up. We assigned to the job a man entirely unfamiliar with the field, so that any time-worn ideas or prejudices would be eliminated at the very start.

The first improvement to be effected was that of equipment. Major changes included standardization of machine adjustment, installation of simple but accurate timing mechanisms, design of a small number of electrodes to meet the requirements of the various product shapes, and the training of the operators in handling the equipment.

This training was accomplished through an operator's school which met in the plant for actual demonstrations. These classes began with a review of the elementary principles of resistance welding and continued through machine and timing adjustment, care of equipment, and quality of workmanship. Appearance of welds was also emphasized, but only after satisfactory weld structure had been obtained.

The net savings have been tremendous. Through the use of an alloy, properly cooled, electrode costs have been cut in half; breakage of welds has been reduced to almost nothing; appearance has noticeably improved. Savings can be shown in many other smaller items such as power consumption, finishing costs, greater volume per machine, and consistency of workmanship. The greatest satisfaction has been the 75 per cent reduction in claims for defective product.

•

Lubricant for Wood Surfaces

W. E. WARNER, *London*

Where wood surfaces rub together, or wood rubs on metal, there often are lubrication difficulties, due to the lubricant swelling the wood, or staining it. A lubricant free from these difficulties can be made from 1 oz. camphor, ½ pt. castor oil, and 2 lb. finely shredded paraffin wax.

The castor oil is heated slightly, and the camphor powdered and mixed in. The paraffin is then added, and the three ingredients well mixed. Sufficient heat is applied to give a complete solution. If the lubricant is to be stored place it in an airtight container.

This lubricant will not be absorbed by the wood, but will remain on the surface and last for some months, depending on severity of the service.

•

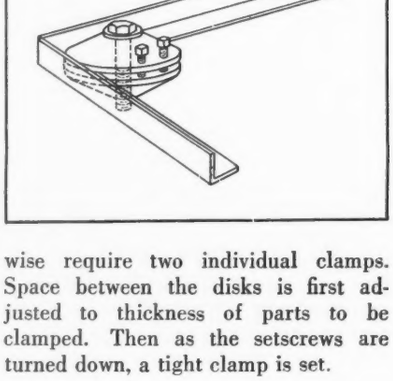
Bench drill stand, mounted on edge of bench on a pipe upright, can be swung out over the bench edge so that long shafts can be supported on the floor and drilled.

•

Circular Clamp for Odd Clamping Jobs

CHAS. H. WILLEY, *Penacook, N. H.*

Made from two round taper disks, a center bolt, and two setscrews, this clamp will hold work that would otherwise require two individual clamps. Space between the disks is first adjusted to thickness of parts to be clamped. Then as the setscrews are turned down, a tight clamp is set.



MAINTENANCE SERVICES

SELECTION • INSTALLATION • INSPECTION • UPKEEP • ORGANIZATION

People and machines engaged in production must be supplied with buildings and with many services, such as electrical and mechanical power, heat, light, water, sanitary facilities, air conditioning, ventilation, dust collection, protection, communication, housekeeping. Providing these services and keeping them in condition for efficient production constitutes the Maintenance Service function. ¶ Practically every activity of maintenance service has to do with the Selection, Installation, Inspection, or Upkeep of equipment. For the benefit of FACTORY'S readers these classifications are carried at the top of the first page of each major article, and check marks are set against the classifications to which the articles belong. A fifth classification — Organization — is checked when the article deals with maintenance department organization and direction

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FACTORY MANAGEMENT AND MAINTENANCE

McGRAW-HILL PUBLISHING COMPANY, INC., 330 WEST 42d STREET, NEW YORK, N. Y.

EDITORIALS

L. C. MORROW . . . *Editor*

Remember Maintenance Too Has To Be Sold

MAINTENANCE WELL KNOWS that management sometimes can be very reluctant to appropriate money for equipment or betterments which, to an engineer, are plainly desirable, perhaps essential. When a request for an appropriation is turned down, maintenance is all too likely to conclude that management's chief function is to say "No" to every good idea.

To be sure, management is sometimes short-sighted in the matter of plant betterments, and refuses to spend any money until forced to do so. Lack of capital may compel the adoption of this attitude, or it may be the result of other factors.

Whenever maintenance fails to get its appropriations, however, chances are at least even that it has failed to "sell" its ideas and plans. Sometimes maintenance doesn't try very hard; or if it does try, its methods and strategy are ineffective. No executive or group of officials ever wants to buy a motor, or a new power drive, or electrical testing instruments, say, just for the sake of buying something. Not even if they are stream-lined or chromium plated. But any executive is decidedly interested in what any kind of equipment will do to lower costs or save money in one way or another.

Realizing this fact, one shrewd maintenance executive attaches a carefully written report to every request for money. In it he explains very simply and clearly just what he expects the equipment to accomplish. Savings and other advantages are given in dollars and cents, whenever possible. The whole project is put on a business-like basis, with no technical phrases to confuse the official who is not an engineer.

Such strategy may not always meet with an instant OK, but at least it commands respect and attention. Without these, any explanations and arguments are likely to be futile.

If You Are Small-Plant Keep Your Eye on the Big Ones

IT'S BIG PLANT STUFF, and no good for me. This sentiment is expressed by too many maintenance executives in small plants when they are told how such and such a large company does its maintenance job. Too many, that is, for their own good and the good of their plants. And, by and large, we don't believe they are right.

Big plants have a way of doing things because they have the money that permits trial and error. But, also, these big manufacturing establishments *must* do things because the cost of not doing them is too great.

Budgeting maintenance expenses, for example. The big plant has to budget exactly the same items the small plant has to budget: Replacement and upkeep of buildings and services; upkeep of production and auxiliary equipment. That's about all there is to it.

Lubrication. There is no difference between the lubrication of a machine in a big plant and one in a small plant. There are just more machines and more kinds of them in a big plant, which adds complications that the little plant doesn't have to worry about.

Motor selection—power transmission engineering—record keeping—order routine. All are the same in principle, regardless of the size of plant.

The whole thing is a good bit like the upkeep on two houses—a 30-roomer and a 5-roomer. Both have roof, walls, floors, foundations. One has a big, complicated heating system, the other a little, simple one. One requires numerous records, the other few. In the one case many man-hours are required to keep everything in shape; in the other, few man-hours. But basically, the jobs are alike.

Simple Ways to Take the Edge Off Hot Weather

WHEN THE THERMOMETER starts hitting the ceiling, workers and production, sometimes products, too, suffer unless something is done to improve conditions. In many plants air conditioning has been found a money-saver.

In plants not yet equipped to make their own weather, several things can be done to offset the effects of high temperature and humidity. For example:

Provide an ample supply of cool drinking water convenient to working areas.

Keep a supply of common salt tablets at each fountain. When taken with drinking water these tablets will replace the salt lost through perspiration and greatly lessen the possibility of heat stroke.

Carbonated beverages are refreshing. They can easily be made available through vending machines.

Shower baths will work wonders on hot, tired bodies.

Turn on unit heaters; put in fans to keep air moving.

Spraying water on the roof is quite effective in keeping interior temperatures down.

Much of the sun's heat can be kept out by using an infra-red absorbent glass in windows and skylights, or by giving ordinary glass a coat of a suitable paint.

Matching Motor, Starter, and Load

GIVEN

1. Two general types of starters, and
2. Four classes of squirrel-cage motors

TO MATCH THEM

1. Consider characteristics of the motor in question
2. Observe the limitations of the power supply
3. Check nature of the load

C. C. LEVY
Industry Application Engineer
Westinghouse Electric & Manufacturing Company
East Pittsburgh, Pa.

C. C. Levy was born in Jamaica, British West Indies. Studied at Jamaica College and at Toronto University, Canada. He has been associated with the Westinghouse Company since 1913. After two years as draftsman he was given the position of electrical engineer, switchboard department, and has since served as general engineer, electrochemical applications; industrial application engineer; and industry engineer in the petroleum, chemical, and mining division. Is a member of the Committee on Electrochemistry and Electrometallurgy, A.I.E.E., and of the Electrochemical Society. Plays golf when he has nothing else to do

MOTORS USED for industrial drives are, in the majority of cases, the polyphase a.c. induction type. All must start occasionally, some quite frequently. They do not all react alike when started. In fact the same motor will behave differently when applied to loads of different character, or when connected to different power systems. These facts all have an important influence on the selection of starters.

When matching a starter with the motor and the load, it is necessary to consider:

1. Characteristics of the motor
2. Limitations of the electrical distribution system to which the motor will be connected
3. Nature of the load

In some instances a motor is selected with certain characteristics to suit the requirements of the starting control, because of limitations imposed by the line. In others, the starting control may be selected to match the characteristics of the motor and the line.

The distribution system must also be considered. High values of low-power-factor starting current are objectionable because of the effect on the voltage of the system. Excessive blinking of lights and low voltage for the other motors which are operating, are undesirable. By intelligent choice of the starting control and the motor, such objectionable effects can be minimized or avoided.

There are two characteristics of the motor that affect its starting: (1) The torque it develops during the starting period; (2) the current it draws from the lines.

Figure 1 shows a series of typical curves in which torque is plotted against speed, from standstill to synchronous speed, for four different types of polyphase squirrel-cage induction motors. Figure 2 shows similar curves for current plotted against speed.

Values of torque and current in these curves are based on full voltage applied to the motor terminals. From them can be determined the starting torque at zero speed, the torque at various speeds as the motor accelerates, and the full-load torque and speed. In the same way the ampere-speed curves give the current values at various speeds during the starting period.

The four classes of motors referred to are described in the following paragraphs. The term "slip" used in these definitions is the generally accepted, but somewhat unfortunate, word indicating that an induction motor never runs at synchronous speed but at some rate that is relatively close to synchronous, as with low-slip motors, or relatively far from synchronous speed, with high-slip motors.

Class A, squirrel-cage motors that

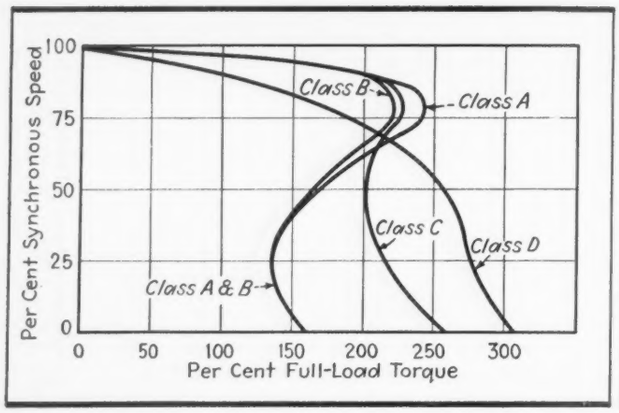


Figure 1. Torque of squirrel-cage motors varies with speed

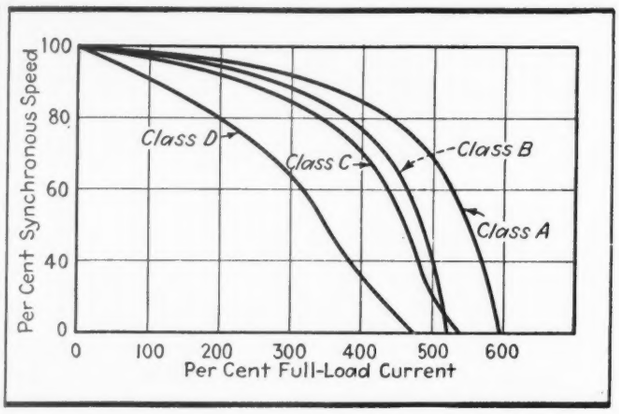


Figure 2. In these curves, motor current is plotted against speed

are designed to develop normal starting torques of 150 per cent of full-load torque with normal starting current of 600 to 800 per cent full-load current, and have a low slip—2 to 3 per cent at rated load.

Class B, motors that have normal starting torque of 150 per cent combined with relatively low starting current—550 to 600 per cent. This value of starting current is obtained by including an inherently high reactance in the design of the rotor. The slip at rated load is relatively low, 2½ to 3 per cent.

Class C, motors that have a high starting torque of 250 per cent and low starting current of 550 per cent. The slip is also low, amounting to 2 to 3 per cent at rated load.

Class D, motors that have high slip (8 to 10 per cent) with high starting torque of 275 per cent. The starting current is low—450 to 500 per cent.

The simplest type of control for starting squirrel-cage induction motors is the full-voltage starter.

Whenever possible this starter should be used because it has the advantage of simplicity and low cost, and permits the motor to develop the maximum available torque when starting. It has the disadvantage of permitting a heavy starting current to flow in the line while the motor is accelerating, which may cause excessive voltage drop and blinking of the lights.

In that event it is advisable either to reduce the voltage applied to the motor by using a reduced-voltage starter or to use a motor that requires less starting current. For example, it might be cheaper in some instances to use a Class B motor, which takes a lower inrush current, than to use reduced-voltage starting.

On the other hand, the effect of reduced-voltage starting on the starting torque of the motor must be considered. See Figure 3. Since torque is proportional to the square of the voltage applied to the motor, there may not be sufficient torque to start and accelerate the load if a reduced-voltage starter is used. If such is the case, a linestarter and a Class C motor which has a high starting torque, but requires relatively low starting current, may solve the problem.

Reduced-voltage starters also offer an opportunity for intelligent matching of the starter with the motor characteristics. There are three general methods of starting at reduced voltage: By the use of (1) an auto-transformer; (2) a resistor; (3) a reactor.

An auto-transformer starter reduces the voltage applied to the motor terminals by transformer action. It is usually supplied with taps which result in 80, 65, or 50 per cent of full-line voltage being applied to the motor.

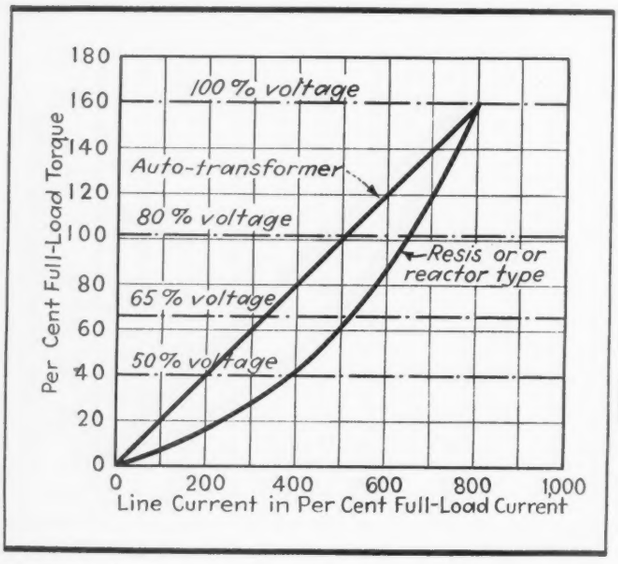


Figure 3. Motor torque and current, on reduced-voltage starting

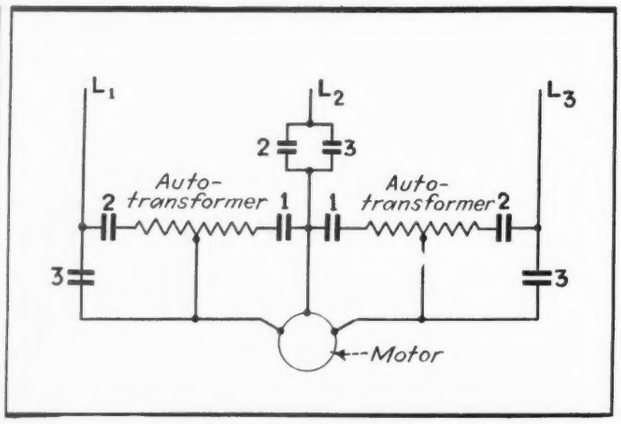


Figure 4. With a reduced-voltage starter of the auto-transformer type the sequence on closed-circuit transition is: (1) Contactors *1* and *2* close to start and accelerate the motor; (2) *1* opens and (3) *3* closes at transition; (4) *2* opens, leaving *3* closed. On open-circuit transition, (1) *1* and *2* close to start and accelerate; (2) *1* and *2* both open at transition; (3) *3* closes

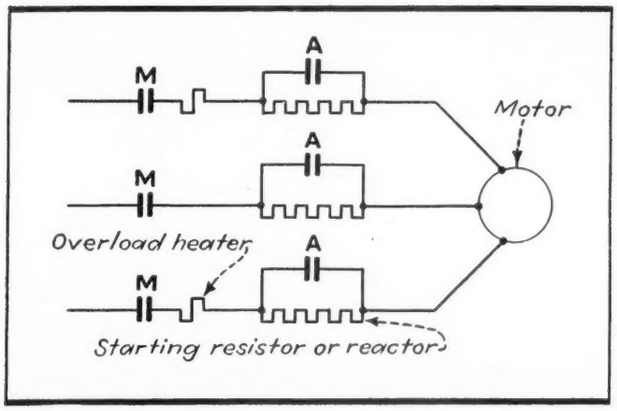


Figure 5. Elementary diagram of a reduced-voltage starter of the resistance or reactance type. When contactor *M* is closed power is applied to the motor. Closing accelerating contactor *A* short-circuits resistance or reactance, applies full voltage

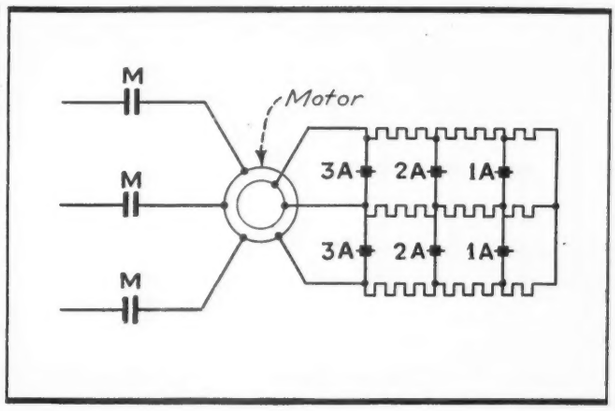


Figure 6. Starters for wound-rotor motors are arranged to put several steps of resistance in the rotor circuit. In this diagram *M* represents the line switch or magnetic contactor; *1A* and *2A* are the accelerating contactors, and *3A* the running contactor

Choice of taps is usually determined by the starting torque required.

The resistor-type starter reduces the voltage applied to the motor by inserting resistance between it and the line. Thus the motor gets a voltage that is the difference between the line voltage and the drop across the resistance.

A reactor starter uses reactance instead of resistance in a similar manner. The elementary diagrams, Figures 4 and 5, indicate the essential differences between the various starters.

Resistor and reactor starters inherently provide closed-circuit transition from the starting connection to the running connection. The circuit to the motor is never opened, the resistance or reactance being short-circuited by the closing of the starting contactors.

Getting the Same Result

An auto-transformer starter can also be arranged to obtain the same result by the use of a two-pole and a three-pole starting contactor, instead of a single five-pole contactor. The elementary diagram in Figure 4 illustrates both schemes.

When reduction of the current drawn from the line is the chief reason for using a reduced-voltage starter, the auto-transformer type is usually selected. For a given torque and a given voltage applied to the motor, less line current is required when the auto-transformer starter is used than with either the resistor or the reactor starter. The reason is that the current in the line is the same as the current in the motor with both the resistor and the reactor starters, whereas with the auto-transformer the line current is less than the current in the motor circuit (as in any transformer circuit) in the same proportion as the line voltage exceeds the voltage applied to the motor.

The curves shown in Figure 3 illustrate this point. Neglecting the effect of exciting current, which is very small, with half voltage applied to the motor the current in the line with the auto-transformer starter is one-half of what it is with the resistor or reactor starter.

Resistor starters are usually limited to a maximum capacity of 100 horsepower at 440 volts because of the very large size of the starting resistance. In special cases, however, motors as large as 1,000 horsepower are started in this way, when it is necessary to meet special requirements for inrush current. In such cases the number of starting steps is quite large.

Reactor starters are more economical than the resistor type in the matter of space requirements, particularly with large motors. They are not, however, so easily adapted to as large a number of starting steps as the resistor starter, and the power factor of the starting current will be much lower with this type than with the resistor starter.

The slight decrease in the starting current as the motor approaches synchronism results in a corresponding increase in the voltage applied to the motor. In some instances this feature gives the resistor and the reactor starters a slight advantage over the auto-transformer. This point might be important when starting a large, two-pole squirrel-cage motor designed for maximum efficiency. In such a case the starting torque tends to be low, so that any increase in the torque as the motor approaches full-load speed is an advantage.

Wound-rotor induction motors use a resistance-type starter, Figure 6, with a number of steps connected in the secondary circuit and a circuit breaker or magnetic contactor in the primary or line circuit of the motor. A very wide range of starting torques, and accurate control, can be obtained in this way.

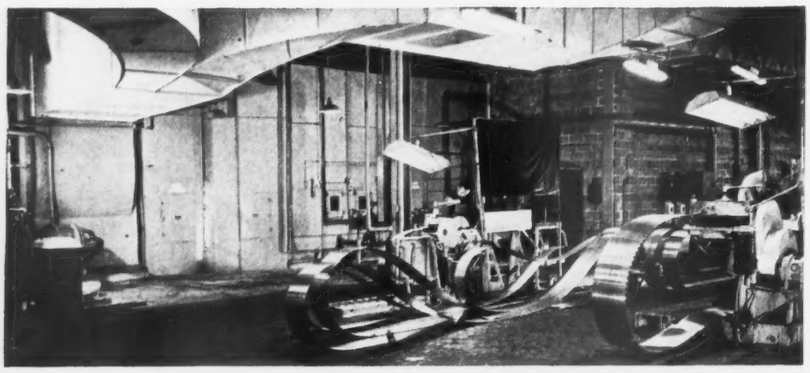
So far the effect of the load characteristics on the starting of the motor has not been discussed in detail. In this respect the most important characteristic of the load is its inertia, or WR^2. This characteristic of the load can be calculated when the weight and dimensions of the driven parts are known. It is important because the energy stored in the rotating mass is equivalent to the copper losses in the rotor of the motor; therefore a high-inertia load means that considerable heat will be developed in the motor during the starting period.

When Starts Are Frequent

Since a thermal overload relay necessarily has a much smaller heat-storage capacity than the motor, difficulty is often experienced in suitably protecting the motor in applications where frequent starting is required. For such applications a type of overload relay which is heated by actual intimate contact with the windings of the motor, rather than by the starting current, is to be preferred.

For example, when a heavy-inertia load such as a centrifuge has to be started and accelerated, a Class C motor and full-voltage starter would be selected. If the running load is intermittent but the starting service is severe, as in a punchpress application, a Class D motor with high slip and a full-voltage starter would be used.

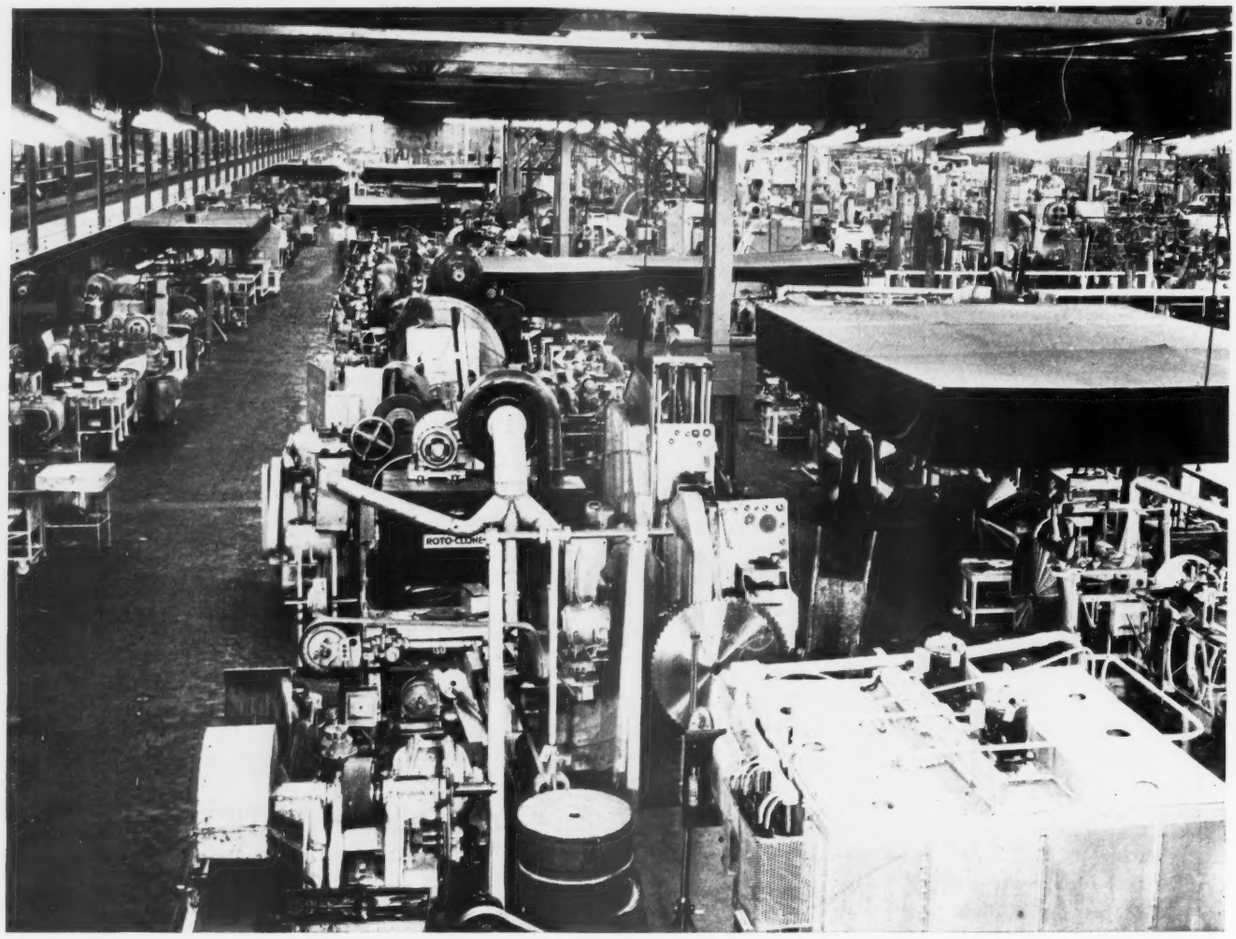
Windowless—and It Works



Some 400,000 cubic feet of air is circulated by this and three other air-conditioning units of the same kind and size. Note wood-block flooring, also fluorescent lighting

IDENTICAL WORKING CONDITIONS for the two 8-hour shifts is the achievement in the newly opened Simonds windowless, air-conditioned factory at Fitchburg, Mass. Eighty hours per week are worked under the same seeing conditions, with uniform temperature and humidity. There are no uncontrollable conditions to affect quality of products and speed of operation. Equipment is at work twice as long as in single-shift plants, thus giving increased service before becoming obsolete.

These were the objectives of the Simonds Saw & Steel Company and the Austin Company, designers and builders, when they began the plant in 1930.



What the production lines look like when seen from transverse portion of walkway. Longitudinal portion of latter is shown at left under lights. Cloth hoods (right center) cover smithing and other operations for which special fluorescent "north light" is provided

Now they are attained, nine years later, after prolonged interruption by the depression.

Design and service details of the plant were given in *Factory* for April, 1939. At that time production equipment had not been installed and there had been no trial under actual operating conditions. Today the eight production lines are in operation. Any one who cares to visit this new windowless factory can see for himself that the effect of the many functional elements in this radically different manufacturing establishment combine to make a thoroughly practical and eminently efficient production unit.

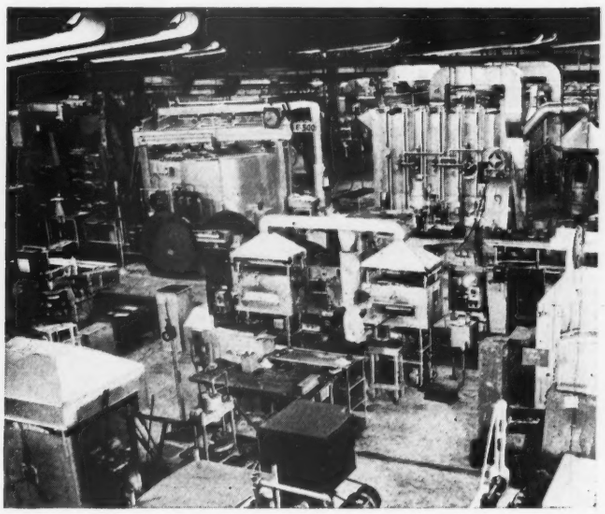
In a single 5-acre room, operations formerly occupying 17½ acres in three plants are performed. Within this room, where there are no partitions and no private offices, are located also the engineering and plant office forces. Forging hammers, furnaces, grinders, air-blasts —all the other kinds of processing equipment—are located "in the line" right where needed.

Little Noise, Clear Air

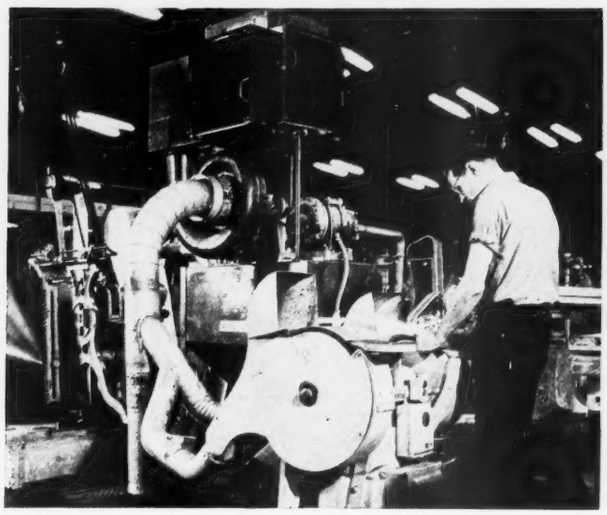
Despite this arrangement, there is remarkably little noise, the air is clear, and there is almost complete absence of shadows. Credit air-conditioning, sound and shock absorbing materials, dust-removal units, fluorescent lamps. Credit also building design and construction, and plant layout.

Sidelights on the Simonds plant: Columns 70 ft. apart in 40-ft. aisles (a total of 56 columns). A 4-ft. elevated walkway, one-quarter mile long, traversing the plant twice longitudinally and twice transversely. Production machines painted yellow; furnaces and benches, aluminum; steel columns, stairs, and walkway, green; ceiling, light cream. 17,000 lineal feet of under-floor power ducts, 38,000 feet of piping, 60,500 feet of galvanized iron conduit, and more than thirty miles of wire and cable. Maintenance forces and equipment located in the center of the room for most efficient service in the entire plant.

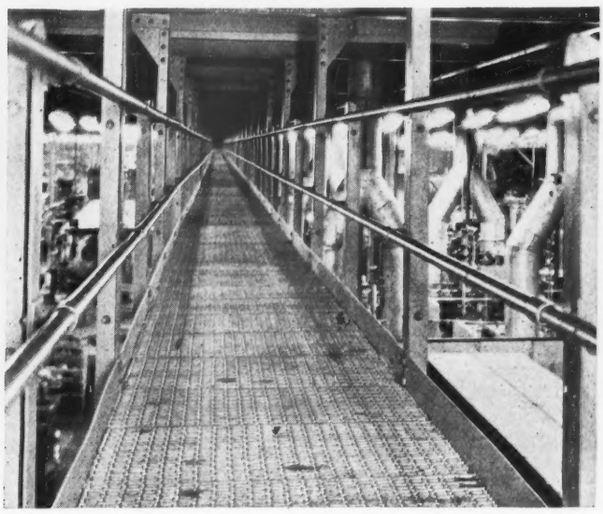
At one end of plant (and at end of production lines) are office forces (foreground) and engineering forces (background). Stairs lead to walkway. Many of the 1,400 fluorescent lights can be seen



More than 70 gas and electric heat-treating furnaces are spotted where needed in production lines. "Man-coolers" blow conditioned air into furnace areas, forcing heated air up to roof ventilators

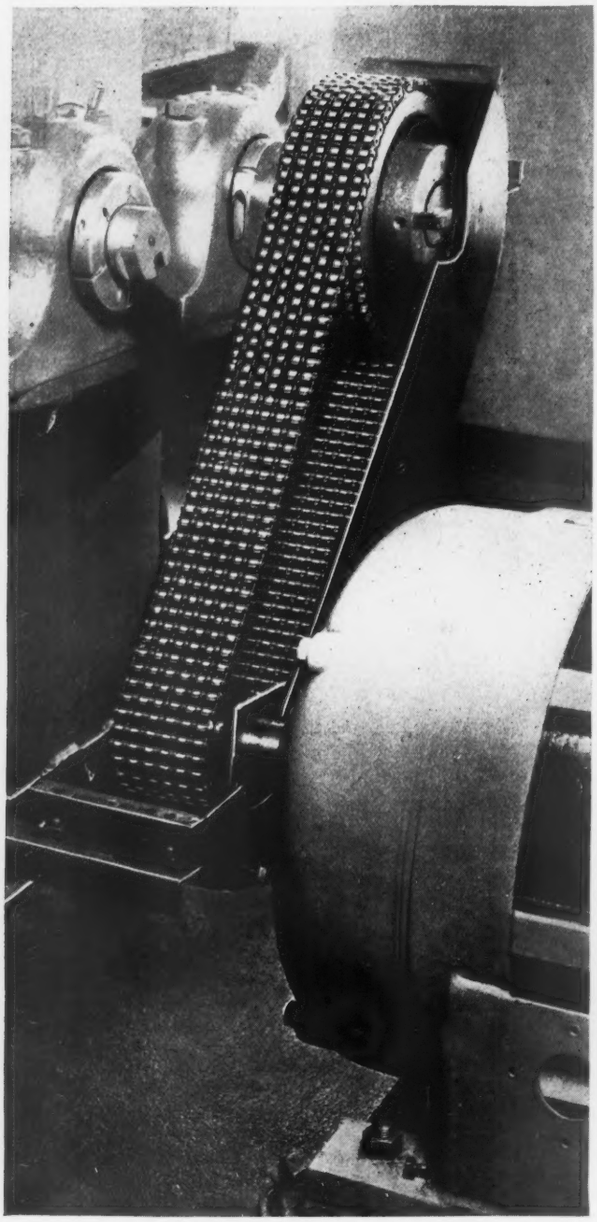


Dust removers keep air free from abrasive and metal dust. Air is filtered through screens (at top of unit), then recirculated

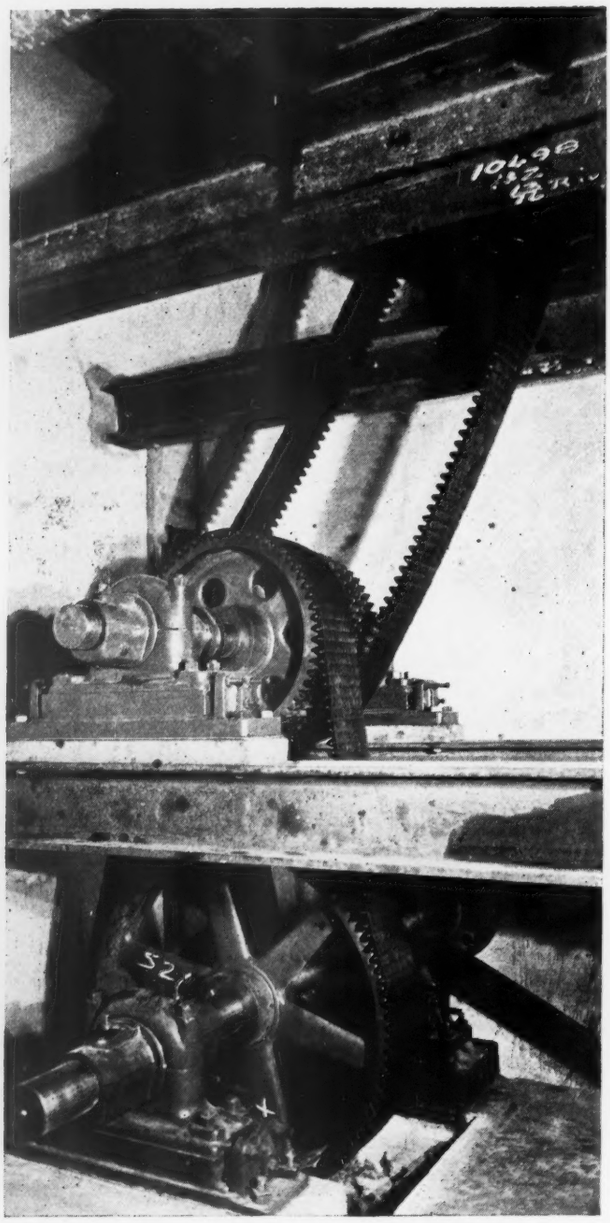


Shown here is about 400 feet of the walkway, suspended from roof trusses. Big advantage is visitors can see everything in safety

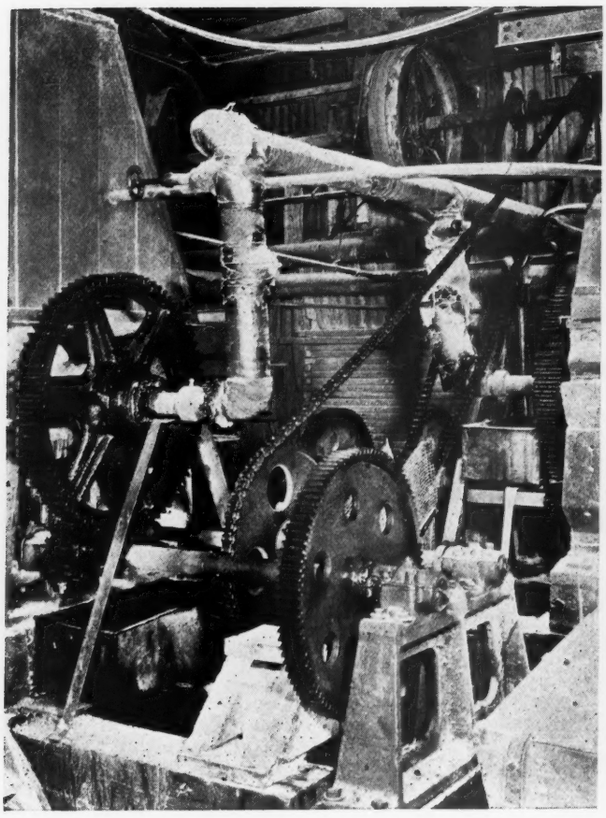
How Chains Do Five Drive Jobs



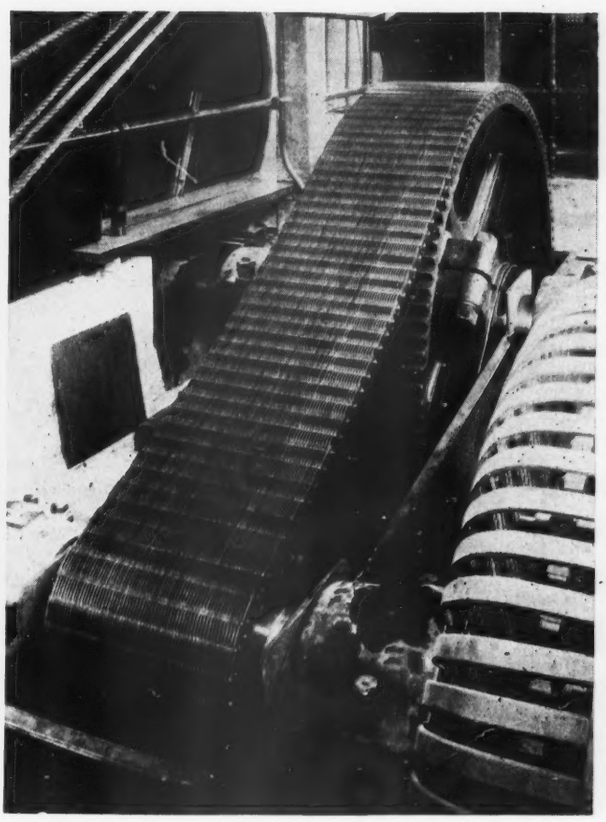
A sextuple-strand, ⅝-in. pitch, roller chain (Diamond) transmits 40 horsepower to a wire machine. Driving and driven sprockets contain 24 and 56 teeth respectively. Center distance, 20 inches



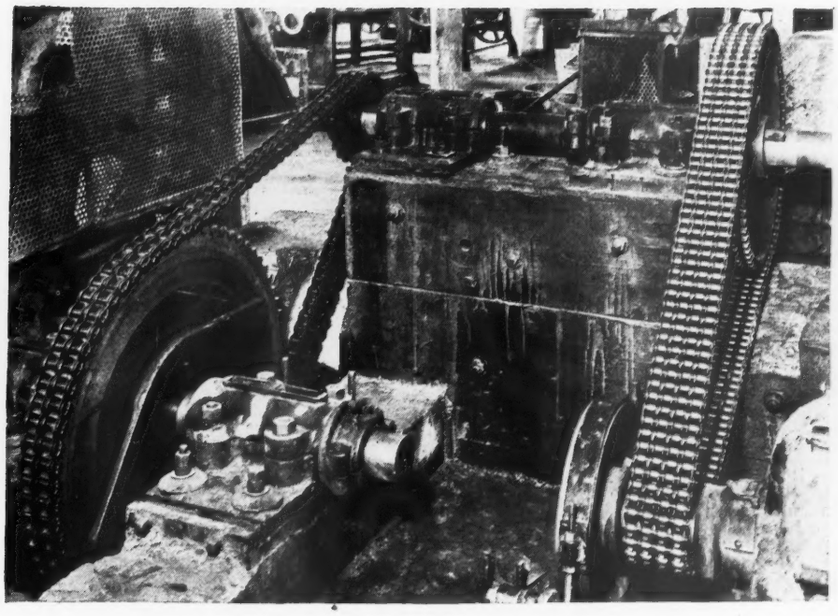
For the main lineshaft in a flour mill a 160-hp. double-reduction drive is required. Chains (Ramsey) are 1½-in. pitch, 10 inches wide, 19 feet long. They speed more than 1,100 feet a minute



'Way down South in a fertilizer plant a couple of roller chains (Chain Belt) have the job of driving sulphate driers. Abrasive dust, in considerable amounts, makes service conditions severe



In service 24 hours a day, this silent chain (Morse) transmits 600 horsepower between motor and a lineshaft driving nine rubber mills. Centers are 72 inches. Sprockets have 23 and 115 teeth



Required reduction in speed between the motor and a paper calender is obtained by roller chains (Baldwin-Duckworth). The shear pin sprocket, at the left, protects against overloads

Maintenance Is the Guardian

ELLIOTT I. PETERSEN

Superintendent, Bigelow-Sanford Carpet Company, Inc.
Thompsonville, Conn.

WE RECOGNIZE our maintenance division as the main guardian of our investment. Because of our huge investment in buildings and machinery, we can be satisfied with nothing less than skill, up-to-dateness, and farsightedness on the part of our maintenance personnel.

Our plant engineer, in charge of all maintenance, has equal rank with any department head. Obviously, he should have, because of his responsibilities. The forces that make possible our continuity of operation are his. They repair, yes—and that is important. But they also anticipate repairs—and that is more important. They do another job without which our operation would be much less effective. This job, as I think of it, is lubrication engineering.

These duties that I have mentioned constitute the maintenance of buildings and equipment. They are duties that maintain the open road—with the go-ahead signal always burning—for the forces that produce the products we sell. However, the maintenance division, under the plant engineer, does a production job all its own. It produces power, light, and heat. This production job we have come to consider every bit as important as the actual weaving of rugs and carpets.

Let me expand somewhat upon the several duties of our maintenance division. Repairs first. Every machine part that shows a repetition of breakage is examined with the objectives of redesign or the substitution of improved materials.

If redesigned parts, or new parts made of different materials, do not solve our problem, our Mechanical Development Department, independent of the maintenance division but cooperating with it, gets busy. It goes as far as necessary to get to the root of the trouble, even to the extent of engineering an entirely new machine or piece of equipment.

Another important function of this department has been the engineering of machine driving mechanisms with the result that we have come from belt and pulley drives to direct driven equipment with solenoid brakes using no clutches.

Second, the anticipation of repairs. A staff of inspectors—part of the maintenance personnel—checks over the larger kinds of equipment such as driers, conveyors, lineshafts, and dye kettles, and recommends repairs where deficiencies are noted before the equipment breaks down and stops production in a department.

Third, lubrication. Another group of the maintenance personnel handles the lubrication of the kinds of equipment just enumerated so that it is not left to the hit and miss methods sometimes encountered in production departments.

Easier on the Oil

Still one more phase of the lubrication work. This group of maintenance personnel has examined into the lubrication of equipment which still retains the old open bearing method of lubrication. Exhaustive experiments were made with all types of lubricating systems on the market. Our maintenance engineers worked with lubrication experts not only on the kinds of lubricating mediums to be used but also to devise new methods of application. The result is that in our newer equipment we have pressure feed tubes ganged in central locations which not only give us a better job of lubrication but have also cut down oil consumption by having the oil do the job in the bearing rather than running down the side of the equipment onto the floor.

Fourth, guardianship. Most of the plants in our locality suffered considerable loss in the 1938 hurricane, because of poorly repaired or badly anchored roofs. Our plant came through without a single dollar of loss due to this disaster. This despite the fact we have buildings that date back to 1848.

Our power house is situated on the banks of the Connecticut River and we all know what happened when the flood of 1936 caught the plants along this river unawares. Our maintenance department not only pumped out the power house, repaired the damaged equipment and put it back in running order, but also protected it against bigger and better floods by raising a dike, combining outlet pipes with suitable shutoff valves, and installed permanent pumps to permit us to operate regardless of hell and high water. Their foresightedness was demonstrated by the fact that not a single hour was lost in the flood of last September even though it reached within a foot and one-half of the 1936 level.

Fifth, and last, production. I have said that we make power, light, and heat. Here we are making a product in competition with the utilities in our area as well as with our normal competitors. In other words, we are in the power business as well as in the carpet business. Outside of the actual raw materials that go into the product our fuel is the largest single item of expense. A fraction of a per cent loss or gain in this item alone amounts to many thousands of dollars. We therefore select our men for power house jobs with exacting requirements in mind. We demand from them the same high standards of efficiency and progressiveness that we require from our regular production department heads. Costs are checked and efficiencies noted exactly the same here as in operating our production departments.

So you see, our maintenance department is partly a production department, partly an engineering department, partly a modernizing department, and just incidentally a repair department. If these functions do not make a man or a department believe in the importance of his existence, I can figure on none that would.

n of Our Plant Investment

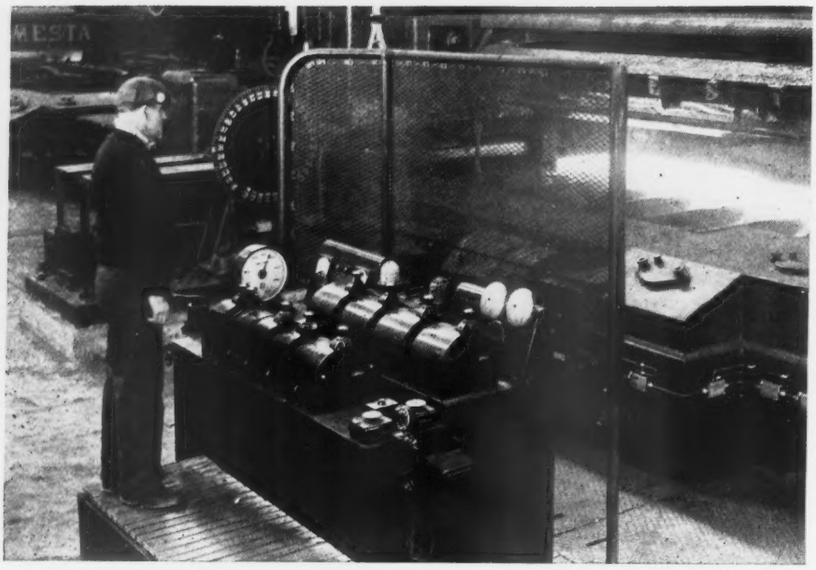
We asked the author for an "informal" picture. He sent the one reproduced above, taken last year at his plant's picnic, saying he hoped we'd recognize him as the figure on the right. (The employees used the other one as a target.)

Petersen has worked for only one company—Bigelow-Sanford — and has been there 24 years. Never went to college. Holds no degrees. Began with B-S washing out pots in the Designing Department; since then has done about everything from sweeping floors to fixing looms. Has worked in practically every department of the business. Is just finishing his 10th year as Superintendent of the Thompsonville Mill, which employs over 3,000 people. He took on his present job at 31, so you can guess how old he is.

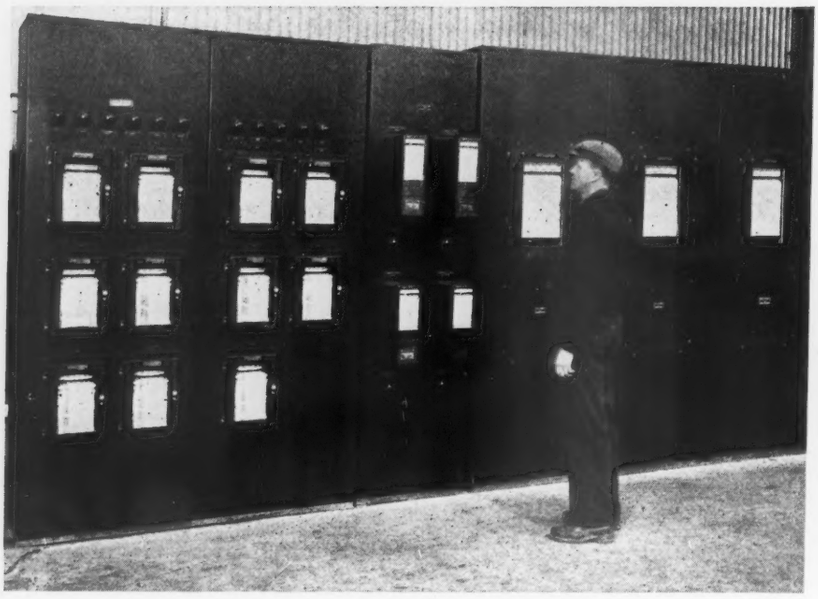
Hobbies: Everything but golf, which he expects to take up after the Social Security pension begins rolling in. Puts in a lot of time with the local Boys' Work Committee and with his own two youngsters

Instruments Tell Quality Story

Quality standards at Irvin Works of Carnegie-Illinois Steel Corporation are maintained by a well-trained inspection force, close cooperation between metallurgical and operating departments, *and hundreds of instruments*



Pyrometer readings at 80-in. hot strip mill control station enable operator to adjust table speed so that proper temperature is obtained before steel enters finishing train



Recording instruments at the 80-in. finishing train supply vital quality-control data

INSTRUMENTAL CONTROL at the new Irvin Works of Carnegie-Illinois Steel Corporation begins at the furnaces, whose panelboards carry combustion control equipment, setting dials, indicating and recording gages, equalizing valves, and air-fuel ratio regulators.

Obviously an article of this length can do nothing more than high-spot the scores of quality control jobs on which literally hundreds of instruments in this plant sit tight.

For instance, to assure close coordination between rolling and heating operations, each furnace operator has on his board a recording pyrometer which shows the temperature being maintained in the soaking zone of the furnace. This is ordinarily held at ± 10 degrees Fahrenheit.

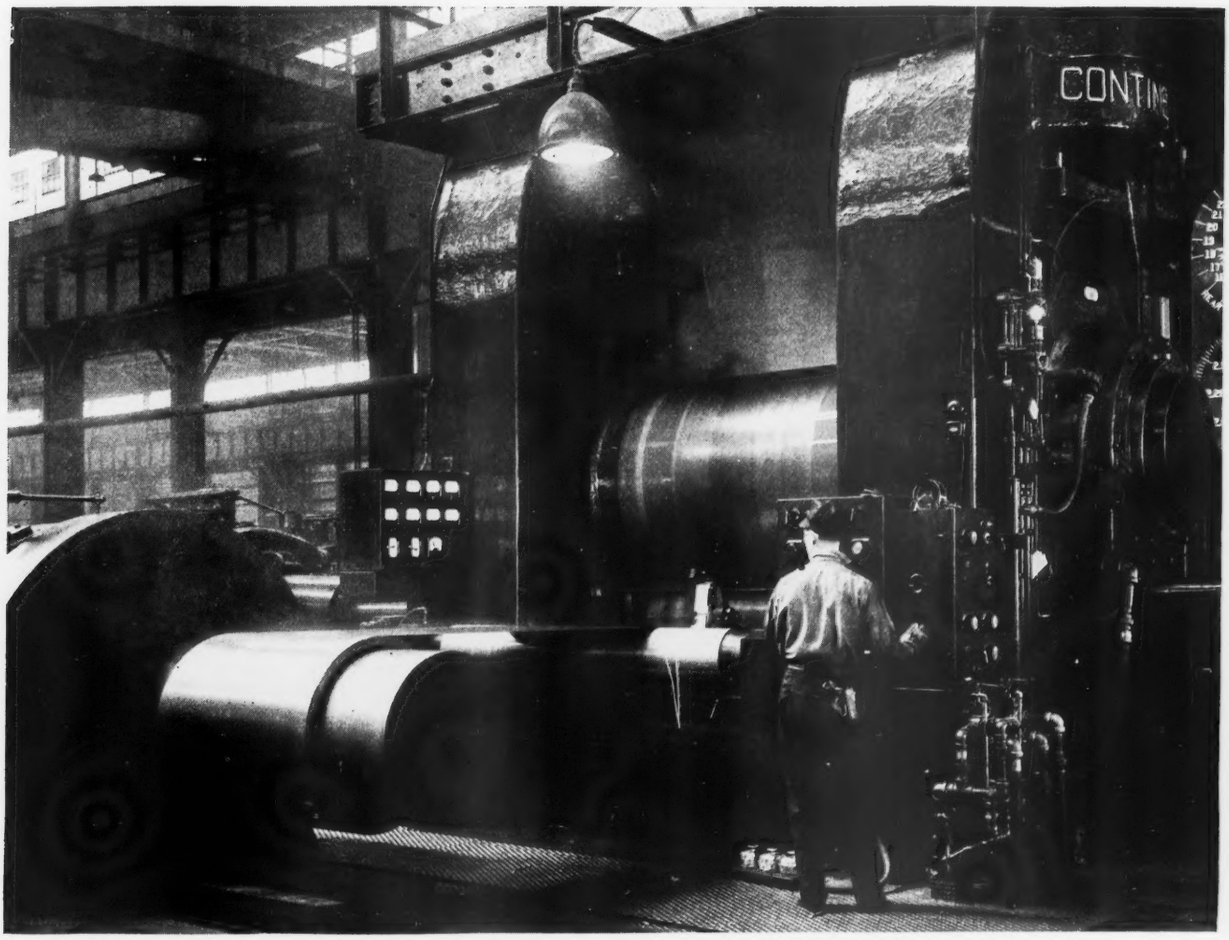
Held Before Squeezing

Similarly, an indicating pyrometer at the spreading mill keeps the operator informed at all times as to the temperature of the slabs he receives. Provision is made for holding the slab before it enters the squeezer in order to assure close control of this operation (which exercises such an important effect on the width and uniformity of the finished strip.) Temperature of the strip as it leaves the finishing train is likewise held at ± 10 degrees Fahrenheit.

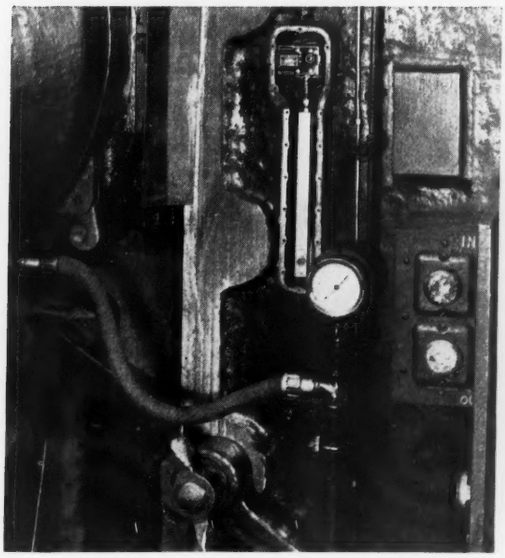
Every facility has been provided in the rolling mill pulpits to maintain quality control. Special indicating and recording equipment enables the operating and metallurgical departments to study the relation between speeds, temperatures, and pressures.

In the roughing mill control pulpit the operator controls table and mill speeds, the necessary instruments being installed on a panel in front of him. Each mill stand is equipped with a built-in strain gage indicating pressure at the stand; the gage is connected with recording units equipped with a selector switch so that records may be kept for study as required.

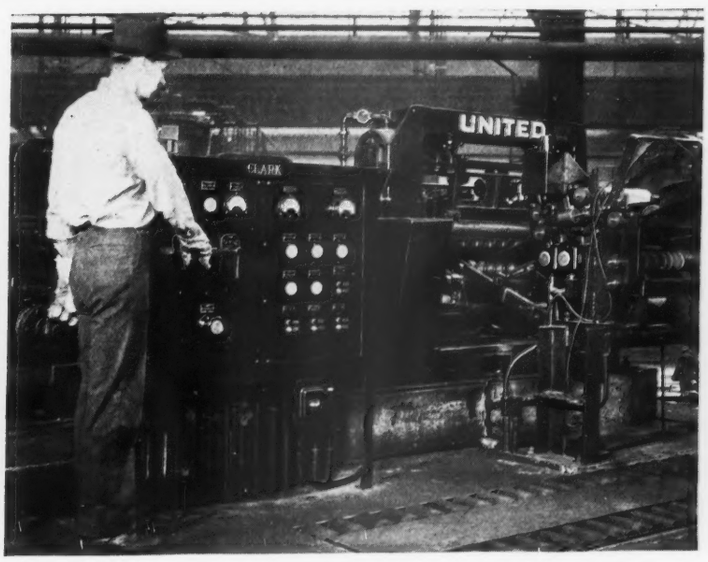
Complete instrumentation is found in the cold reduction department. Flying micrometers keep the operators and inspectors advised as to the gage of the product leaving the mills.



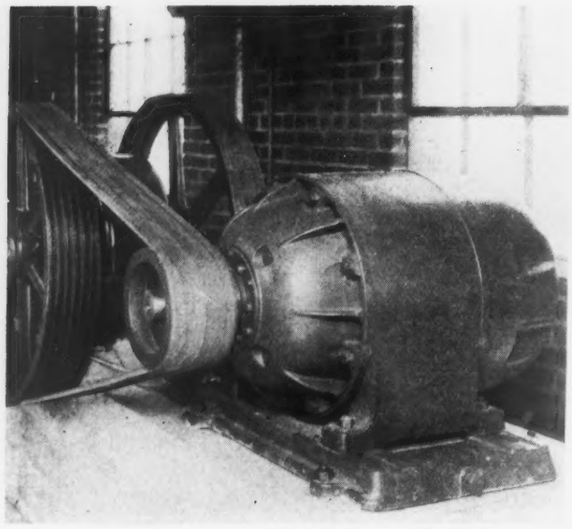
Delivery end, 84-in. 3-stand tandem cold reduction mill. Instruments allow mill operators to balance and control the screwdowns and roll pressures on all stands, also roll speeds and tension at entering and discharge ends of mills as well as between stands



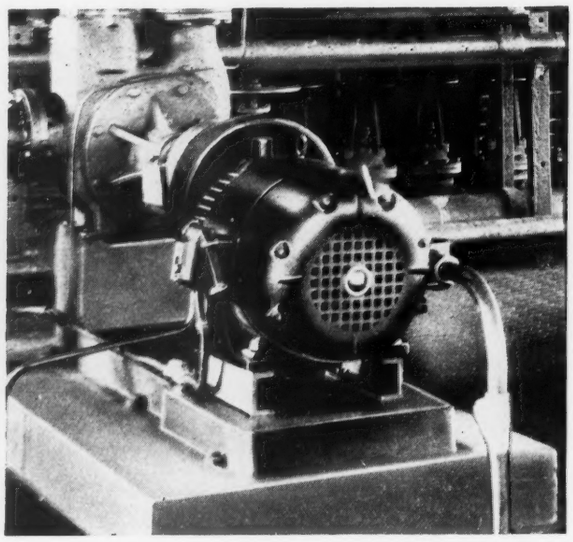
Indicating strain gages (this one is uncovered) play an important part in the adjustment of roll pressure



Control board at one of the tin mill shear lines. These lines operate at strip speeds up to 350 feet per minute, call for close instrument control

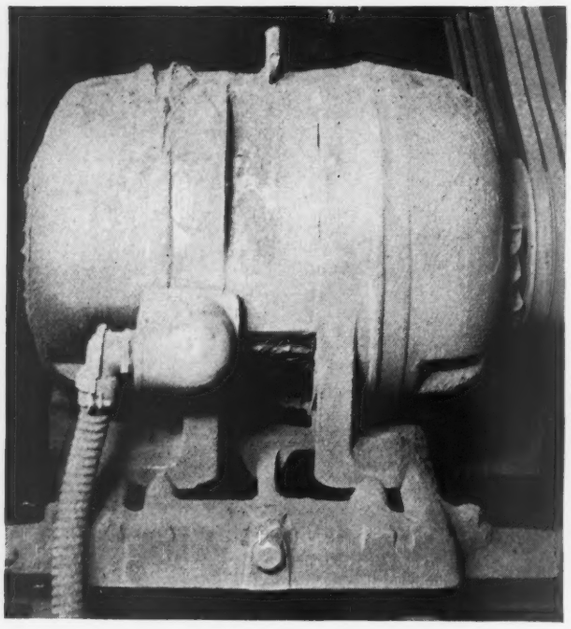


Here a compressor handling butane gas is driven by a 30-hp., 220-volt, explosionproof (General Electric) induction motor

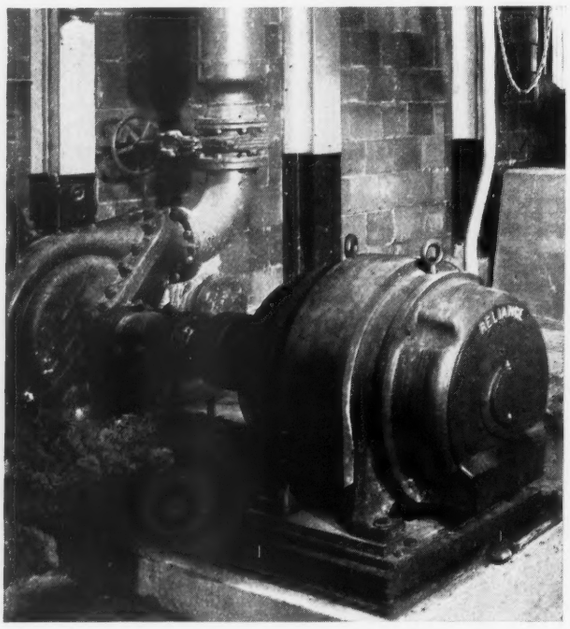


A 20-hp., explosionproof gearmotor (Master) drives a pump giving 400 gallons of naphtha per minute at 80-lb. pressure

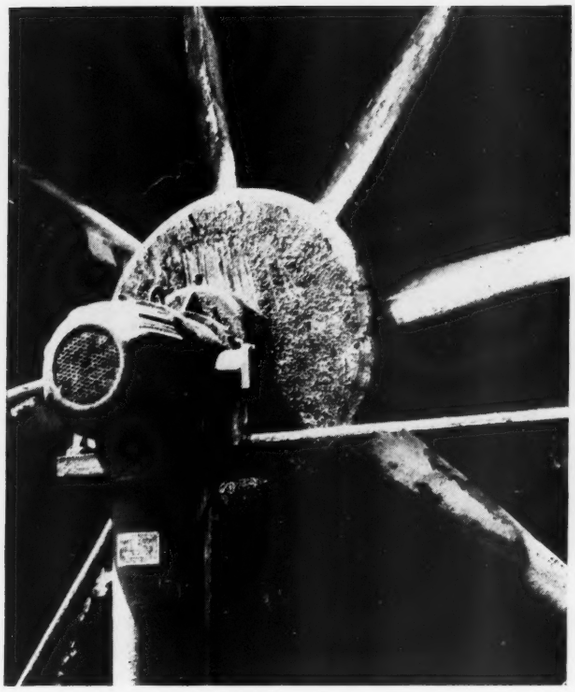
These Motors Laugh at Dust and Gas



Driving a fan on a heat-treating furnace is the job given to a 5-hp., totally inclosed, fan-cooled (Fairbanks Morse) motor



At clean-up time in a paper mill they turn a hose on this stock pump and the splashproof (Reliance) motor driving it



Outdoor life doesn't hurt the 20-hp. totally inclosed, fan-cooled gearmotor (Westinghouse) driving a cooling tower fan

An inclosed, 200-hp. synchronous motor (Elliott), cooled by outside air drives a 48-in. rock crusher in a dusty atmosphere

Lots of sand falls on the 3-hp. inclosed (Allis-Chalmers) motor driving a conveyor in the shake-out pit of a foundry

There are explosive gases around this rubber shearing machine; so it is driven by an explosionproof (Wagner) motor

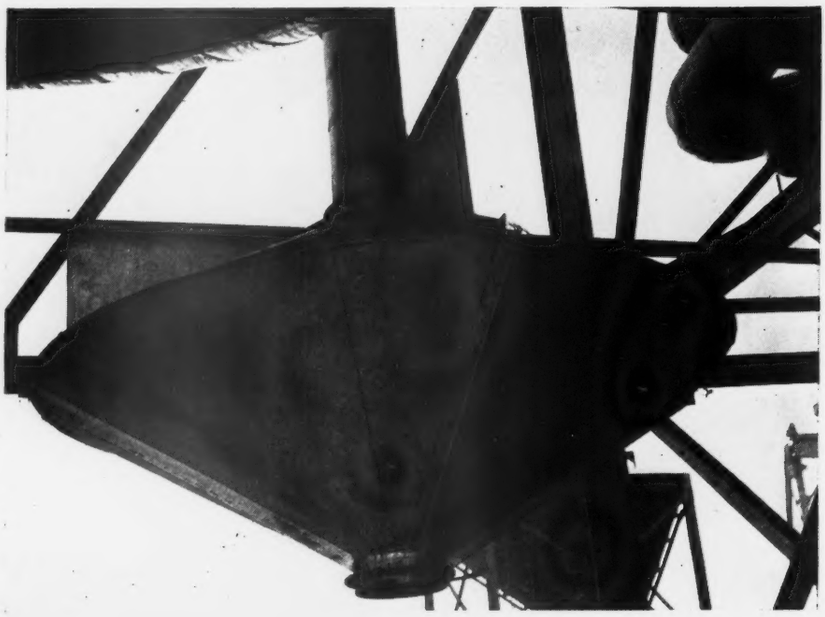
Quick Exits for Smoke and Heat

It may be next to impossible to keep a foundry as cool and smoke-free as the deck of a Bermuda-bound boat, but modern ventilating equipment has gone a long way toward making this foundry a good one to work in. Imagine the results you'd get on somewhat simpler jobs

AN EXHAUST SO STRONG that it pulls flames from freshly poured molds away from the workmen and toward the exhaust ducts, indicates the power and capacity of the foundry ventilating system at Pontiac Motor Division, General Motors Corporation, Pontiac, Mich. Coupled with air inlets discharging temperature-controlled fresh air directly to areas where men are working, this exhaust equipment rids the foundry of smoke, heat, and gas by continuously changing the air.

Along the line where cylinder blocks are cast, strong suction fans exhaust the smoke and gas from the air at the rate of 106,000 cubic feet per minute. This exhaust draws the dense columns of smoke away from the workmen so that they work in clear air. Along the sections of the line where men are stationed, 36,000 cubic feet of fresh air are fed in every minute, directly over their heads. Temperature of the fresh air thus introduced, is automatically controlled by steam heat.

Another feature of the ventilating and cleaning system is the sand and dust collecting system in the knock-out department. Shaking cores out of the motor blocks is an extremely dirty operation, and this installation keeps the air clean. Three tons of sand and dust are removed from the collector daily.



In the cylinder block knock-out department, where cores are shaken out of the castings, a collecting system gathers sand and dust, and accumulates it in this collector. Three tons are removed every day

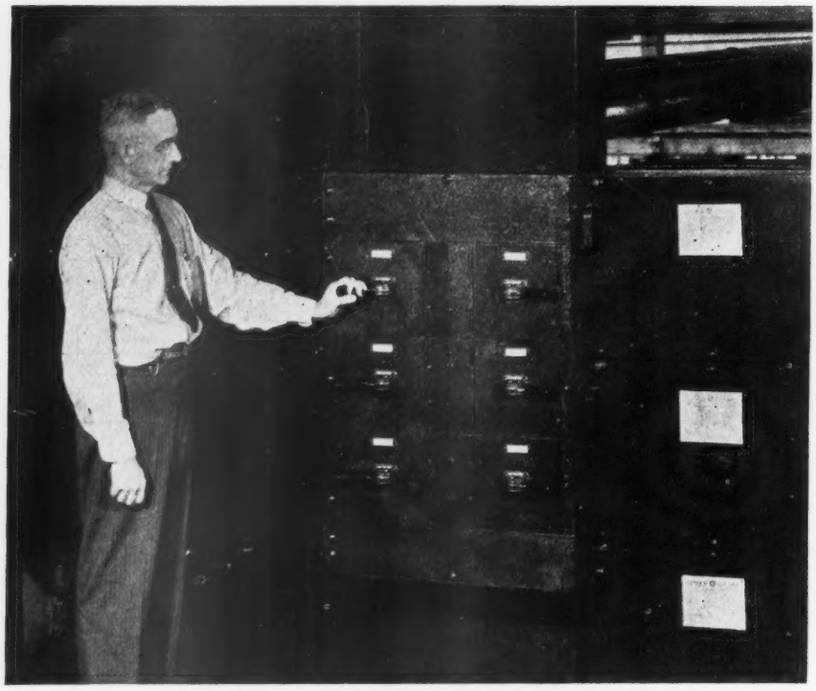
Fresh air intakes, located directly over the work stations, feed clean air at controlled temperatures to the motor block line, thus replacing hot, smoke-laden air carried off by the strong exhaust action

Flames, gas, smoke, and heat are literally pulled away from this man on the line where clutch housings are cast. Were it not for ventilating system, which at this point exhausts 50,000 cubic feet of air per minute, his would be a decidedly uncomfortable task

So strong is exhaust suction along the cylinder block line that it actually pulls flames toward the exhaust duct openings. Heat, gas, and smoke are carried off so fast that operators always work in a clear atmosphere. Fresh-air inlet just shows at the right

Re-Wired for Profit

Lower power losses, less voltage drop, and flexibility adequate for all needs are the important advantages secured from a new electrical distribution system



SIDNEY W. WATKINS

Electrical Engineer, The Warner & Swasey Company, Cleveland

Standing beside the large pull boxes at the distribution center on the second floor of the main building, the author looks over a new, 200-kva. installation of capacitors. Mr. Watkins is a graduate electrical engineer, Ohio State University, and has been associated with Warner & Swasey for 27 years. He is a past president of the Electrical Maintenance Engineers Association, and is now serving his second term as member secretary of the Board of Review for the Electrical Code, City of Cleveland. Having spent some time in Texas his favorite relaxations are horseback riding (western style) and target rifle shooting

INSTALLATION of a new electrical distribution system throughout our plant was recently completed. It will give us lower line losses, better voltage conditions, and much greater flexibility than we have ever had.

In designing the electrical power distribution system for an industrial establishment one is quickly brought face to face with the questions of economy and flexibility. Rarely is the most economical system satisfactory from the standpoint of flexibility. In any plant a system of power distribution that does not provide for expansion and flexibility of supply is indeed inadequate.

To give a better picture of the conditions, it may be noted here that our plant comprises ten large buildings. The two main buildings are five stories high, with basement, whereas the others have one or two stories.

At present we are operating about 500 motors, ranging from fractional to 75-hp. rating.

Formerly about 75 per cent of our electrical load was on direct current, the remainder being carried on the a.c. supply. Approximately one-third of the power used was generated in our own power plant. Feeders ran from the main switchboard to the basement of the two main buildings and then rose vertically to the top floor. Taps were taken off to six panels on each floor. From these panels branch circuits were carried to the various machines.

The natural result of this arrangement was a considerable drop in voltage on the upper floors. This condition, in turn, was made worse by the addition of many new machines and modern, high-speed cutting tools, and the radical shifting around that had taken place since the distribution system was first installed.

The layout and condition of the old distribution system made complete replacement advisable. The work had to be done, of course, without interfering with production.

Before starting the job we took plenty of time to study our requirements, fix definitely in mind just what we wanted, and plan everything with care. It was desired, for example, to make wider use of a.c. motors and throw out a large number of the old d.c. machines, eliminating group drives wherever possible. Now about 75 per cent of our load is carried by a.c. equipment, while 25 per cent is on direct current. Most of the d.c. load consists of cranes, elevators, planers, and some other machine tools.

Further, we wanted the new a.c. distribution system to have a large measure of flexibility for future changes in machine layout. Voltage drop must, of course, be kept low. Obviously we wanted also to plan a system that would most economically provide all the features we felt it must have.

To avoid the excessive voltage drop experienced with the old system, it was decided to feed the vertical risers at about the mid-point. Therefore, the 220-volt, three-phase feeders from the main switchboard are carried in conduit mounted on the ceiling of the second floor.

There are a number of panels on each floor of the different buildings. In the main building, for example, there is a total of 30 panels, or six on each of the five floors. The panels on each floor are placed directly over those on the floor below. Each vertical group of panels is

fed by a separate line from the main switchboard.

The vertical risers are of the same capacity as the main feeders throughout their length. The branch circuits in the panelboards are standardized at 100-amp. capacity and vary in number from six to ten, depending upon the area and type of building served. With this arrangement the full capacity of the feeders is made available at any of the panelboards.

The flexibility of this system easily overcomes the economical objections to the extravagant use of copper, especially if the distance between panelboards is reasonably short, as here.

Easy-to-Apply Connectors

Incidentally, solderless connectors were used throughout the new distribution system. They are easy to apply, save installation time, are convenient in making changes, and have given us no trouble.

Several groups of small motors are fed from separate sub-panels which in turn are fed from the 100-amp. branch circuits.

Whenever possible the branch circuits were run beneath the floor and brought up alongside the machine served. Our floors are wood laid over a concrete base. Hence it was not a difficult matter to lay the conduit between the wood and the concrete.

All starters are pushbutton-controlled. Motors up to 40-hp. rating are started across the line. With larger motors a two-step compensator, also controlled by pushbutton, is used.

In addition to the uses of direct current mentioned earlier, we frequently have occasion to test machines driven by d.c. motors. Also, from time to time we may wish to install production machines driven by this type of motor. Accordingly, we installed four d.c. panels on each floor in order to make direct current conveniently available throughout the shop areas. These panels are designed for a.c. service, but we adapted them for direct current by connecting and fusing only two of the three legs.

They are supplied by some of the old feeders originally installed in the basement. From the electrical standpoint there was no reason why these feeders could not be used. By doing so we were able to make a worth-while saving. All wiring above the basement is new.

Along with these changes in the power distribution system, the lighting system was completely revamped. When the old system was laid out and installed many years ago, the intensities commonly used were considerably lower than those required today. As larger lamps and more of them were put on the lines the point was reached where further stepping up of the illumination would have seriously overloaded the system.

A new three-wire, single-phase, 230/115-volt system was therefore laid out and installed on the same general principles followed in the power distribution system. For example, the old system was supplied by feeders in the basement. In the new system the vertical risers are fed at about the mid-point on the second floor, considerably increasing the capacity of the system and reducing voltage drop.

New fixtures were installed throughout, and the average intensity is now between 14 and 18 foot-candles in all the working areas. The lighting fixtures are of 500-watt capacity, although only 200-watt lamps are being used at present.

We have learned by experience that it is highly important to keep the lighting and power circuits entirely separate. That is, when lighting circuits are supplied from the power transformers there are likely to be annoying flickering and dips as the load changes or when large motors are started up. Our lighting system is therefore supplied by separate single-phase transformers connected directly to the incoming high-voltage power lines.

There are four panels on each floor, each of which controls the lights within a certain area. Lights are all controlled by switches in the panels; no pull chains are used. In some places the lights are controlled from sub-panels fed from a main panel. Each panel switch controls four outlets for general lighting.

Individual lighting supplied by 50-watt transformer mounted on motor switch. Transformer case contains fuses for primary circuit and a receptacle for plugging in lamp

Flexible Lighting

To provide greater flexibility the groups of four lamps are arranged in a straight line, when they are close to windows, and in the form of a square, in the interior of the departments.

Local lighting is required for many of our machines. On the other hand, we like to avoid the use of ordinary drop-lights. To get around this situation we have mounted small transformers, 50-watt rating, on these machines. The primary of the transformer is connected across two of the 220-volt power leads, while the 115-volt secondary supplies the machine lights.

When machines have to be shifted around there is no need to add to or change the general lighting system, since each machine carries its own lamp.

MAINTENANCE SERVICE SHORTS

Readers are invited to contribute brief illustrated articles reporting out-of-the-ordinary maintenance accomplishments. Accepted articles will be paid for

Heating, Ventilating, and Air Conditioning

Soldering Fumes Removed at Their Origin

SOURCE

Zenith Radio Corporation, Chicago

A ventilation method especially applicable in any plant department where ventilation is needed at scattered points, is used in the chassis assembly departments at this plant. Here, in a large room about 100 by 200 feet, with hundreds of soldering operations going on, the air is kept clear by an installation that has roof vents at only two points over the entire area, and with only eight exhaust blowers, four on each of two platforms at the vent points.

The ventilation system is localized rather than general. From the eight overhead exhaust blowers, ducts come down in two clusters to the assembly lines. Each row of tables carries a double assembly line, one on each side. On top of the parts rack on each table runs a service duct, one duct serving a hundred feet of double assembly line. The exhaust duct from overhead joins this service duct halfway between the two ends.

Exhaust openings are provided every 30 inches in the horizontal service duct, but these openings are closed with air-tight lids, except at points where an operator uses a soldering iron. At such a station the lid is removed and in its place is set a portable vent made of flexible pipe. The operator bends this pipe to whatever position catches the smoke from her iron to best advantage.

Thus the air is kept clear by removing the contamination at its source, rather than letting it spread through the room and then having to move a much larger volume of air. Much smaller footage of down ducts is needed than if the service duct were high overhead. A minimum of shadows and obstructions results from this installation; also, the service ducts are cleaned of exterior dust when the tables are cleaned. The only parts of the system that require dusting from ladders are the down ducts and the runs from these to the blower platforms. Interior cleaning is provided by cleanout lids every 6 feet, so that a man can reach inside from one to the next.

A future advantage is that if ever the department is moved, the only costly moves of ventilating equipment would be of the overhead platforms, roof vents, and down ducts. The rest is attached to the work table, but easily detachable from it for moving.

Adjustable vent directly above the work catches practically all the soldering fumes

•

Aluminum paint, used on roofs, reflects the heat rays and keeps temperatures inside the building down. Where buildings are air conditioned, this paint cuts cost of operating the air conditioning system by reducing the load.

•

Cleaning Filters with Air Cuts Replacements

WILLIAM P. HARSH

Hall Brothers, Inc., Kansas City, Mo.

Our new building has a rather elaborate system for bringing in fresh air from the outside, heating it to the proper temperature, humidifying and circulating it. There are seven separate filtering units: four contain eight honeycomb filters each; one contains twelve; another contains three; and one large unit contains seventy-two.

After the first two months these filters were very dirty, and the air passages so clogged that the proper amount of clean, filtered air was not being delivered. Investigation showed

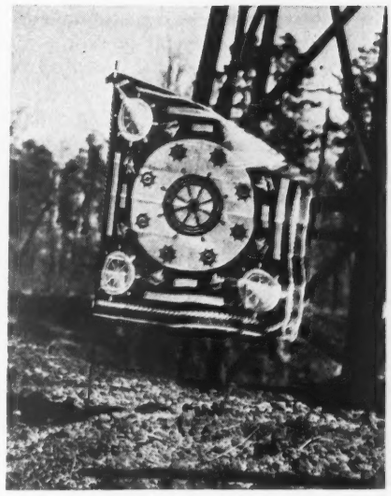
that many companies periodically dispose of the dirty filters and install new ones. This seemed to be rather expensive, since these filters cost from $.80 to $1.25 apiece. To eliminate this expense we worked out two plans, both very satisfactory, of which the second plan is more desirable than the first.

The first plan involves taking the filters out of each unit and brushing them thoroughly with a stiff bristle brush. This cleaning removes most of the dirt, but it is not a perfect job because some of the dirt lodges in the "honey-comb" of the filter. After the brushing operation a good grade of special oil, which is sold by most oil companies, is brushed on the surface of the filter. The oil restores its original stickiness and causes the dust and dirt to cling to the filter, rather than pass through.

In the second plan the face of the filter is cleaned by means of compressed air. This is a rather dirty operation and is done in a small room, so that the dust will not be blown about. No special attachments are necessary; all one needs is a short piece of rubber tubing with a petcock at the end so that the air may be turned on and off. In addition to cleaning the surface of the filter the blast of air gets all the dust and dirt out of the inner pores.

The oiling operation is the same as before. For applying the oil a 3-in. paint brush serves very well.

The average filter, if properly handled, can be cleaned from ten to fifteen times before it needs to be replaced. We keep one extra set on hand so that when the dirty ones are removed for cleaning the fresh set can be installed immediately thereby giving us clean, filtered air at all times.



BUILDINGS AND SERVICES

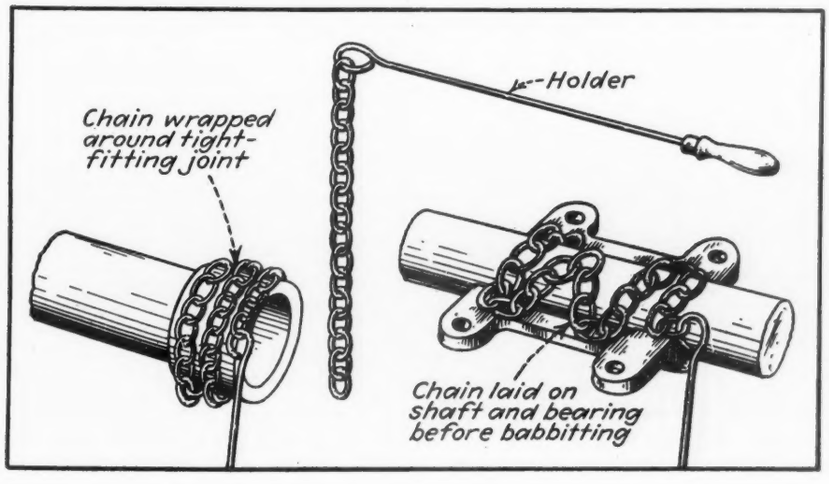
Warms Up Cold Joints with Hot Chain

H. MOORE, *Leeds, England*

It is not generally known among repairmen that a short length of chain makes a handy heater or preheater on jobs where other means of heat are not available—either because they do not exist in the shop, or because an open flame would be objectionable.

I use a chain attached to a simple holder made of steel rod driven into a file handle. When this chain has been heated to a cherry red in a furnace, I can carry it quickly to where it is wanted. If some tight-fitting part needs warming to make it easier to get off, or some compound on the joint must be melted, I wrap the chain around it as many times as it will go.

This chain is also very useful for warming up a bearing and shaft before babbitting, as it provides a greater area of contact than is possible with solid pieces of metal.



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Maintenance Gang Hangs Out the Flag

CHARLES C. LYNDE, *Kilgore, Tex.*

In far-flung industries such as refineries and chemical plants, it is hard to keep track of the location of the maintenance gang and the maintenance supervisor.

One oil company has solved the problem by sending out a small, identifying flag with the party, this to be displayed on some easily visible point. With such a flag, it is easy to dispatch a messenger directly to the spot where the gang is working when the gang or some member is needed elsewhere.

Ordinary bandanna handkerchiefs are used for flags. A white or light-colored one designates presence of the plant electrician, a red bandanna represents the maintenance gang, and a blue flag denotes presence of the yard superintendent.

By fixing short standards on elevated points, such as tanks, water towers, and embankments, and equipping each standard with a pair of spring clothespins, it is easy to affix flags to the standard.

•

Cut Down Sunday Repairs; Saved $400 a Month

ROY KIPPERT, *Mechanical Engineer*
Kimberly Clark Corporation
Niagara, Wis.

One of our problems was the increasing cost of Sunday maintenance overtime. It was our practice to hold a foremen's meeting every Friday morning to discuss the coming Sunday's work lineup. Each maintenance foreman would give the master mechanic a list of the jobs requested by the operating departments, which he figured on doing.

On one particular Friday morning, as each foreman gave his list to the master mechanic, we found that there were very few jobs listed for the coming Sunday. The master mechanic asked the reason, and one of the foremen replied that it was Easter Sunday and that they were giving the men a break.

That statement set me to wondering

why we couldn't make alternate Sundays Easter Sundays as far as the work was concerned. I took the idea up with the plant engineer and the master mechanic and it sounded good to them. The idea was then presented to the operating superintendents with a request for their cooperation. We told them we were only going to have a handful of men in for routine inspection on the light Sundays, and not to request any work on those Sundays unless it was an emergency.

Over a period of six months a saving of $400 a month was realized and our maintenance costs did not go any higher as a result of this light-and-heavy Sunday program.

Power and Light

Mirror Shows Boiler Water Level

JAMES O. G. GIBBONS, *Bloomfield, N. J.*

The article appearing in the January issue interested me because by similar use of a mirror I was able to overcome a difficulty in watching the water gage glass on a new boiler.

Some time ago we installed a boiler in an extension to an existing boiler house, at the same time converting all boilers to oil burning. This meant that most of the time it was necessary to have only one man in the boiler room. But unless the fireman stood close to the gage glass on the new boiler, it was difficult for him to keep an eye on the water line of the new boiler, because the new boiler was placed at right angles to the old boilers and the width of the new boiler was greater than that of the passageway in front of the old boilers, so that his view of the gage glass was cut off.

As soon as the new boiler had been started up, I received a complaint about the fireman's inability to see the glass from any point in the boiler room. To remedy the situation I installed a light and mirror on the boiler front. The light was mounted at the water column, and the mirror was placed in such a position that the fireman could see the gage glass reflected in it when working in front of the old boilers.

I was agreeably surprised to find that the water level could be seen more clearly in the mirror than it could be when viewed direct.

•

Rotating Standard Meters Simplify Testing

C. O. VON DANNENBERG, *Tulsa, Okla.*

It is often necessary to conduct tests when load fluctuations make it difficult to obtain accurate readings, particularly if a full set of indicating instruments is used, consisting of voltmeter, ammeter, and wattmeter (one polyphase or two single-phase meters.) A three-phase motor would require simultaneous readings of three or four meters, assuming a sufficiently balanced load to make unnecessary an average value of three currents and three voltages.

If only three meters are to be read simultaneously errors are possible which will lead to inaccurate results. Therefore, any method of simplifying tests without loss of accuracy is worthy of consideration.

I have found, after numerous tests, that when voltages between lines and amperes per line are sufficiently balanced, ammeters may be eliminated from routine tests. If value of current is required, a single reading, or a calculation based on the average of three voltage readings, will suffice. For a no-load reading a clamp-type ammeter was found to be accurate enough for routine tests. During a load test, such a meter will indicate unbalance.

Tests were all made with watthour meters of the rotating standard type. Using this type of meter it was possible to test fluctuating loads and obtain far more accurate readings than when indicating meters were used. An average reading was recorded as a total quantity in one unit; therefore, it was not necessary to average a number of indicated readings.

When making a test the meters are allowed to register for a suitable time period. If the load fluctuates or changes through definite periods, preliminary tests may be necessary to show the approximate time. During starting periods or for higher load values of a cycle, a short time interval is necessary. By inserting pendent or cord-type switches in the voltage (potential) circuits of the meters, they can all be started or stopped together.

Registration of the meters during a certain period will be in watthours or kilowatthours, depending on the transformers used.

Calling the values of the quantities recorded by the meters W_1 and W_2, where W_2 is the greater, these calculations will apply.

1. *Total Watts, or Kilowatts* $= W_1 + W_2$.

2. *Total Reactive Volt-amperes or Kilovolt-amperes* $= \sqrt{3}(W_2 - W_1)$.

3. *Total Volt-amperes or Kilovolt-amperes* $= 2\sqrt{(W_2^2 + W_1^2) - W_2W_1}$.

Letting $A = W_1 \div W_2$, then:

4. *Power factor, in Per Cent* $= 50\sqrt{(1 + A)^3 \div (1 + A^3)}$. It may also be expressed, $50(1 + A)\sqrt{(1 + A) \div (1 + A^3)}$, or $50(1 + A)\sqrt{1 \div (1 + A^2 - A)}$.

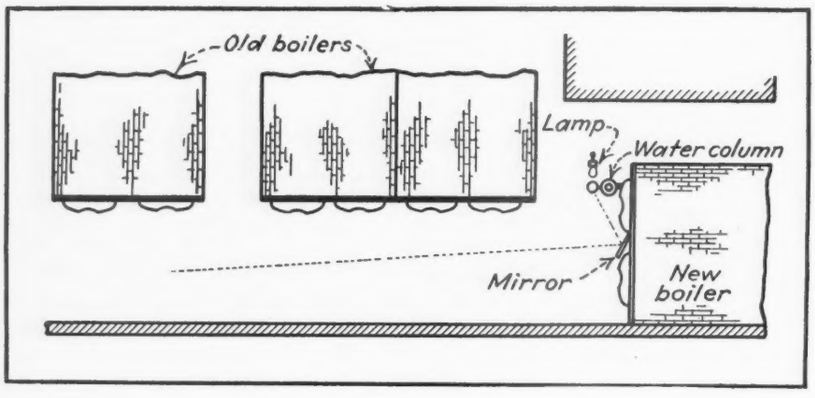
5. *Reactive Factor, in Per cent* $= 86.6\sqrt{[(1 + A^2 - (A^2 + A)] \div (1 + A^3)}$.

6. *Tangent Factor (Ratio of the Reactive Factor to Power Factor) in Per Cent* $= 173\ (1 - A \div (1 + A)$.

Amperes may be calculated from one, or the average of three, voltmeter readings by the formula:

7. *Amperes* $=$ *Watts* $\div$ (*Volts* $\times$ *Power Factor (decimal)* $\times \sqrt{3}$), where the values of watts and power factor are obtained from *1* and *4*.

The procedure described makes it possible to conduct tests with a minimum of equipment and personnel, and secure results having an accuracy not readily obtainable when more conventional methods are used.



MOTOR TROUBLES
Symptoms, Causes, Remedies

Continued from the July issue

Prepared by THE MASTER ELECTRIC COMPANY *Dayton, Ohio*

H. MOTOR IS NOISY

CAUSES	Symptoms: *Determine by inspection*	*TESTS AND REMEDIES*
1. Worn bearings (See I).		1. See I.
2. Rough commutator or high mica between bars.		2. See F-1.
3. Unbalanced armature.		3. Return complete motor to factory for correction or replace with spare armature.
4. Brushes fit too loosely in the holder.		4. Replace brushes.
5. Armature out of center.		5. Ship motor to factory for correction.
6. Insufficient end play.		6. Oil thoroughly.
7. Excessive end play.		7. If end play exceeds 0.010 in. on ball bearings or $\frac{1}{32}$ in. on sleeve bearings tighten adjusting nuts.
8. Air gap not uniform.		8. Replace the bearings.
9. Loose accessories such as condulet box, guards, etc.		9. See that end covers, guards, etc., are tight.
10. Motor mounted on foundation that is not solid or that vibrates when motor is running.		10. Make sure that motor is properly fastened to its foundation.
11. Bearings not properly assembled.		11. Make sure that adjusting nuts are tight. If ball bearings (1) remove dust caps (2) tap races to see if properly seated.
12. Motor out of line (coupling or gear drive only).		12. Loosen motor foot bolts and re-align with machine.

I. WORN BEARINGS

Symptoms: *1. Excessive noise* *2. Excessive vibration* *3. Rotor striking field*

1. Insufficient lubrication.	1 and 2. Replace bearings and lubricate thoroughly.
2. Wrong kind of lubrication.	
3. Belt too tight.	3. See that belt is just tight enough to prevent slipping during starting and running periods.
4. Coupling or gear out of line.	4. See H-12.
5. Excessive end play.	5. See H-7.

J. GROUNDED FIELD OR ARMATURE

Symptoms: *1. Loss of power* *2. Slow speed* *3. Blown fuses*

Grounded Field—Determine by using series lamps or magneto test from motor leads to frame.

Grounded Armature—Test from shaft to commutator.

1. Copper dust or other conductive dusts.	1. Remove all oil, dust, or dirt from the motor.
2. Oil or dirt on brush-holder parts or where coils enter the slots in the field.	2. Look for bare wires near end cover bolts, end of the slots, or where leads are soldered.
3. Defective insulation.	3. Wipe commutator with dry rag.
4. Mechanical damage to insulation in handling.	4. Clean mica between commutator bars.
5. Overheating sufficient to char the insulation.	5. On Type RA, single-phase motors, if segments touch the commutator the armature will be grounded.
6. Damaged winding.	6. If windings make contact with frame, re-insulate.

K. SHORT-CIRCUITED FIELD OR ARMATURE

Symptoms: *Armature short-circuited in a.c. motor. The shorted coil will center under the stator coil and become excessively hot. If d.c. motor, it will operate at speeds below normal for all loads and the shorted coil will get very hot*

Regardless of cause proceed as follows:

1. Solder between commutator bars where armature leads are connected.	1. Inspect the soldering of the commutator leads to see that solder does not touch two commutator bars at once.
2. Damaged winding.	2. If windings have been damaged and two bare wires are

MOTOR TROUBLES
Symptoms, Causes, Remedies

CAUSES — *TESTS AND REMEDIES*

K. SHORT-CIRCUITED FIELD ARMATURE (Continued)

touching each other, re-insulate with varnished cloth or tape.
3. If trouble is not removed by (1) and (2) return the motor direct to the factory for repairs.

L. OPEN-CIRCUITED FIELD OR ARMATURE

Symptoms: *1. Burnt mica between bars nearest open circuit*
2. Excessive sparking around commutator
3. Refusal to start at certain portions of the armature
4. Failure to start, generally accompanied by a humming sound when motor line switch is thrown on

1. Broken wires.
2. Defective soldering.
3. Damaged winding.
4. Lead wires disconnected.
5. Commutator leads loose.

1. Examine line fuses to make sure they have not blown. This is especially important with two- or three-phase motors.
2. See that the motor is properly connected to the line.
3. If a broken wire is apparent make the repair and re-insulate the splice with friction tape.
4. Check point where motor leads connect to the winding.
5. Resolder any loose commutator leads. If open circuit cannot be located return to factory for repair.

M. IMPROPER CURRENT SUPPLY

Symptoms: *1. Motor overheats* *2. Motor is noisy* *3. Refuses to start* *4. Line fuses blow*

Replace the motor with one built for operation on the local power circuit.

N. WORN BRUSHES

Symptoms: *1. Motor refuses to start* *2. Motor not up to normal speed*

1. Overload.
2. Natural wear.
3. Rough commutator.

1. See A-9.
2. Replace with new brushes. Fit the new brushes to the curvature of the commutator.
3. Polish the commutator with sandpaper (never use emery paper) or take small cut off in a lathe.

O. MOTOR TOO SMALL

Symptoms: *1. Will not come up to speed under load* *2. Excessive or continuous sparking*

1. Check speed when testing for wattage input.
2. Relieve part of the load or use a larger motor.

P. STICKING BRUSHES

Symptoms: *1. Motor turns but will not always start* *2. Excessive flashing at the commutator*

1. Presence of dirt or foreign matter in brush holder.
2. Rough spots on brushes.
3. Brush tension spring incorrectly applied.

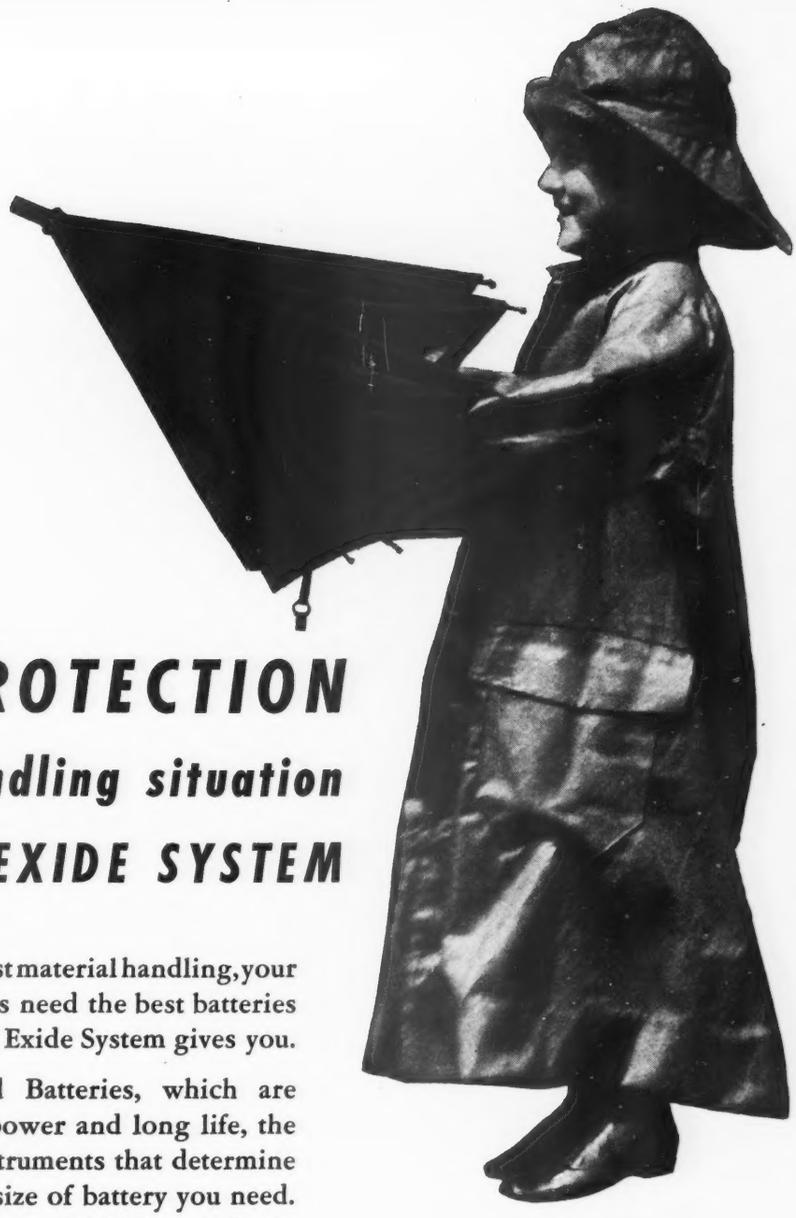
Press down on brushes. If motor starts remove brushes, clean out holders and sand with No. 00 sandpaper. Also sand the commutator.

Q. BRUSHES NOT MAKING CONTACT

Symptoms: *1. Loss of power* *2. Excessive sparking* *3. Refusal to start*

1. Brush spring tension weak.
2. Brush spring not in proper position.
3. Brushes not properly sanded.

1 and 2. Correct brush spring position or replace with new springs.
3. Sand the brush until it conforms to the commutator curvature.



COMPLETE PROTECTION

in any material-handling situation

ASSURED BY THE EXIDE SYSTEM

FOR fast, efficient, low-cost material handling, your electric industrial trucks need the best batteries you can get, plus . . . what the Exide System gives you.

Based on Exide-Ironclad Batteries, which are packed with performance, power and long life, the Exide System starts with instruments that determine scientifically what type and size of battery you need. For example, there are now Exide-Ironclads in capacities of 1000 ampere-hours and more, that make child's play of fifteen-ton loads.

To insure the utmost in performance after the battery is installed, the Exide System includes a discharge indicator that mounts on your truck, flashing a visual warning when the battery nears the discharge point . . . cutting delays and "tow-ins." The Exide Charge Control Unit, which mounts on your charging panel, automatically controls the rate of charge, then cuts the circuit and flashes a signal when the charge is complete. Naturally, more materials are handled faster . . . at minimum cost. Why not write for details?

Exide
IRONCLAD
BATTERIES
With Exide MIPOR Separators
"MIPOR," Reg. U. S. Pat. Off.

THE ELECTRIC STORAGE BATTERY CO., Philadelphia
The World's Largest Manufacturers of Storage Batteries for Every Purpose
Exide Batteries of Canada, Limited, Toronto

You Want to Know

more about the items mentioned on this page.
Letters to the addresses given will bring information

• FROM A TOY to a municipal stadium is the range of use of "Kem Lustral" enamel, says its manufacturer. Versatility is this finish's middle name, for it can be brushed, sprayed, dipped, air-dried or baked, and applied to wood or metal surfaces subject to exterior or interior exposure. Sherwin-Williams Co., Cleveland.

• TOLEDO'S COMEBACK from depression and labor strife is dramatically told in "300,000 Guinea Pigs," a booklet describing the salient features of the Toledo Plan and the results it has achieved in rehabilitating the city. Toledo Associates, 240 Huron St., Toledo.

• MACHINES have meant better products, better jobs, better wages, and, ultimately, more jobs in the automobile industry, a pictorial booklet shows. "Men, Methods, and Machines in Automobile Manufacturing" deals with the relationship between mechanization and employment. Automobile Manufacturers Association, 366 Madison Ave., New York.

• HARD SURFACING POWDER, for metal surfaces that must be hardened to resist impact, abrasion, or corrosion, is spread to a depth of two or three times the desired thickness, then welded on with carbon arc welder. Lincoln Electric Co., 12818 Coit Rd., Cleveland.

• ALUMINUM STAGES for supporting men working off the ground—painting or repairing walls and ceilings, rigging pipes and shafting—are light in weight, lessening danger that men moving them will suffer strain or rupture. They come in lengths from 8 to 25 feet, widths from 12 to 24 inches. Aluminum Ladder Co., 122 Adams St., Tarentum, Pa.

THIS VACUUM CLEANER'S field of usefulness widens with appearance of the "Skraptrap," an attachment that collects small objects such as bolts, screws, and nails, and prevents their reaching the dust bag. Which means it can be used around such places as stock bins, as shown here. Another aspect of its application is its ability to recover valuable waste material from the dust and dirt accumulations around benches and machines. Breuer Electric Manufacturing Co., 5100 North Ravenswood Ave., Chicago

• DECIMAL EQUIVALENT CHART, with all the usual equivalents from $\frac{1}{64}$th to $\frac{63}{64}$ths, is a decalcomania that can be transferred to a T-square. Frederick Post Co., Box 803, Chicago.

• EXECUTIVES wondering how best to furnish employees information about their company will want copies of a report summarizing the experience of 160 companies in the use of letters, reports, posters, meetings, contests, employee magazines, and the like. Policyholders Service Bureau, Metropolitan Life Insurance Co., 1 Madison Ave., New York.

• MULTI-PURPOSE TOOL "takes off the last thousandths" from steel, soft metal, and wood. Powered with a 110-volt universal motor, it chips, saws, files, burrs, hones. Pushbutton on grip provides instantaneous control. H & H Research Co., Book Bldg., Detroit.

• FANS for exhausting corrosive and hazardous atmospheres have baked-on multiple chemical coating that is said to keep severest acid and practically all metal-corroding substances from destroying the fan blades. Autovent Fan & Blower Co., 1805 North Kostner Ave., Chicago.

• SALT TABLET DISPENSER of black plastic comes along just in time for the summer jump in salt tablet consumption. When an employee working in a hot location steps to the water fountain all he has to do is turn a knob at bottom of the dispenser, and a single tablet drops into his hand. Davis Emergency Equipment Co., 55 Van Dam St., New York.

• DEODORIZER, electrical and tamperproof, operates from a.c. lighting supply, and produces ozone to destroy washroom odors. It is secured to wall by padlock and has removable adjustment key to prevent unauthorized removal or adjustment. The Automatic Electrical Devices Co., Cincinnati.

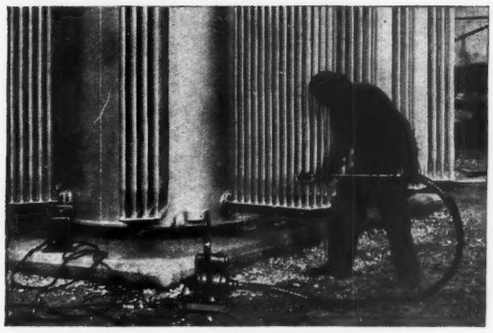
• SOLVENT which is said to combine soap and water detergency with solvent performance of benzines, leaves a rust-preventive film on parts cleaned with it. The Curran Corp., Malden, Mass.

• MOISTURE DETECTOR, electric, spots moisture in a surface or sub-surface. When needle electrode is pressed into material in question, a battery-operated indicating needle shows whether material is wet or dry. Colloid Equipment Co., Inc., 50 Church St., New York.

• FLASHLIGHT has its own generator, operated by a few turns of a spring wind. Aluminum case incloses all parts so that the flashlight can be used in hazardous locations. Genaflash Co., Albany, N. Y.

How to do it?

Many factory men have found these G-E maintenance tools helpful



TANK-AND-TUBE CLEANER

For preparing metal surfaces for repainting, you can't beat this tank-and-tube cleaner—a motor-driven device with a complete set of brushes and attachments. (We designed it for cleaning transformer tanks and tubes, but it has many other uses.) It's easy to use, and it might pay for itself on the first job. Ask for publication GEA-3014.

PORTABLE OIL TESTER

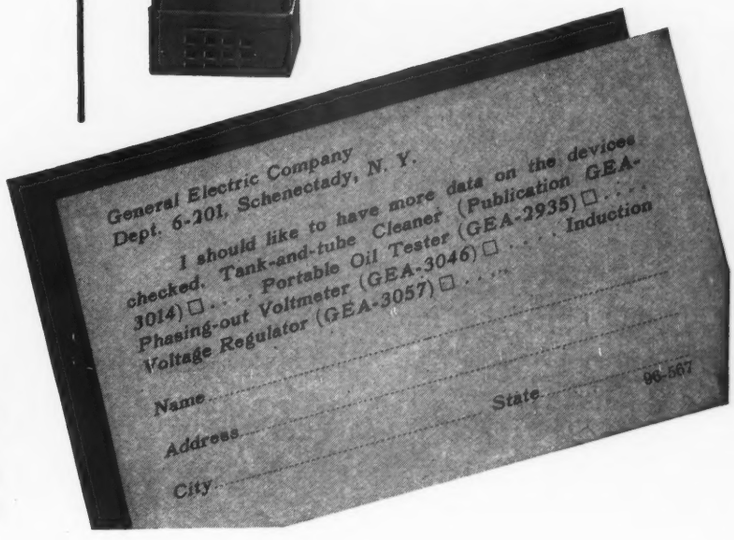
Test your oil regularly. That's the one way to make certain of its dielectric strength and thus help assure successful operation of high-voltage apparatus. This new device provides you with a convenient and accurate means of testing. It weighs only 78 pounds. See publication GEA-2935.

PHASING-OUT VOLTMETER

"What we need is a light, sturdy, high-voltage voltmeter for phasing-out distribution circuits and transformers." Have you ever heard this? Here is an instrument to meet the need. Just another helpful tool in General Electric's complete line of testing instruments. Remember, whenever you need an electric measuring instrument, General Electric has it. Ask us today for publication GEA-3046.

NAME YOUR VOLTAGE

Turn the crank and you have the voltage you specify. This new, hand-operated induction voltage regulator is just what you need for testing. It gives 100 per cent raise and 100 per cent lower—zero to 240 volts from a 120-volt circuit. Comes in handy on the production line or for repair and maintenance work. Send for publication GEA-3057.


General Electric Company
Dept. 6-201, Schenectady, N. Y.
I should like to have more data on the devices checked. Tank-and-tube Cleaner (Publication GEA-3014) □ . . . . Portable Oil Tester (GEA-2935) □ . . . . Phasing-out Voltmeter (GEA-3046) □ . . . . Induction Voltage Regulator (GEA-3057) □ . . . .
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GENERAL ELECTRIC

What's New in Equipment

Circuit Breakers

Type AB-I circuit breakers are built with a "no-fuse" mechanism. When the circuit is opened the handle automatically indicates "tripped." When cause of interruption is removed, handle is manually turned to "reset" and then to "on" thus restoring service. Available with several types of inclosures: general-purpose sheet

steel with grounded neutral, dust-resisting sheet steel, weatherproof cast iron. The general-purpose sheet-steel type is equipped with hinged cover; felt gasket; knockouts in top, bottom, and sides; cover interlock. Colt's Patent Fire Arms Mfg. Co., Hartford, Conn.

Welder

Model WA-200 square-frame welder for multi-arc service requires approximately 3½ sq. ft. of floor space, and has a welding range from 40–225 amperes. Consists of a one-piece frame and a rotating member. Attachments such as external exciters, reactors, resistors, are eliminated. It is said to have automatic volt-ampere regulation, self excitation, internal stabilization of the welding current. Spring-mounted louvres can be snapped on and off for inspection of brushes and commutator, or for minor adjustments. Top and plates are removable. The units may be hooked in parallel without special adjustments to gain any desired welding amperage. Harnischfeger Corp., 4400 West National Ave., Milwaukee.

Hand Lamp

"Big Beam" electric hand lamp No. 1000 differs from No. 411 in that it is lighter and is powered by a 9-volt Burgess, replaceable, dry-cell battery. It has an all-steel, baked-enamel container; a polished-aluminum handle; a chromium lamp head. An interchangeable floodlight lens diffuses the light over a wide area for close-up work. With the regular lens, a ray over 2,500 ft. long is said to be projected. Wiring and dewiring are unnecessary when changing battery as lamp contacts are made automatically when the container top is snapped in place. Accessories are available for anchorage to a flat surface or for complete-circle focus. U-C Lite Mfg. Co., Dept. F.M., 500 North Dearborn St., Chicago.

Hole Saws

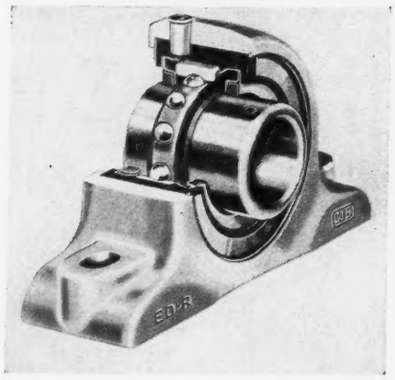
Line of high-speed hole saws, for hard alloys and production work, is used in ¼-in. or larger drills for cutting holes in material a hacksaw will cut. Mandrel, for ¼- and ⅜-in. drills, can be used to drive hole saws up to 1¼ in. in diameter. Hole saws are adaptable in attaching hot water heaters to boilers; running pipe lines or electrical conduit through floors and walls; installing oil burners, stokers, and automatic blowers in furnaces; setting new dials in instrument panels. The Black & Decker Mfg. Co., Towson, Md.

Lift Truck

Lift truck that weighs approximately 2,550 lb. has a rated load-handling capacity of 2,000 pounds. It is powered with a 6-hp. gasoline engine. Its speed is rated at 4 mi. per hr. forward and reverse. It is controlled with an instantaneous reversing friction

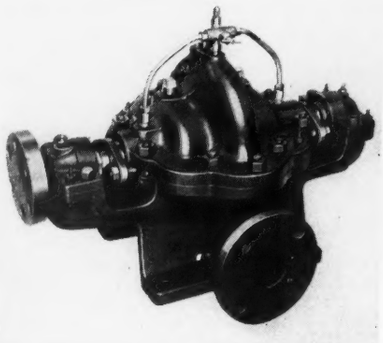
clutch. Drives through 2 rubber-tired front wheels; is steered by a single wheel in the rear. Wheel base measures 43 in.; turning radius is 50 in.; load may be lifted 9 ft.; length of load forks is 24 inches. Vaughn Motor Co., 835 S.E. Main St., Portland, Ore.

Sound-Insulated Pillow Block



Series ED-R pillow blocks for light duty find application in domestic air-conditioning units, and attic fans. To eliminate noise and vibration, the bearings are insulated from the solid die-cast housings by Neoprene cushions. Neoprene seals are of floating construction to eliminate friction. Provision is made for normal misalignment. The bearing is electrically grounded. Available in ½-, ⅝-, ¾-, $\frac{13}{16}$-, and 1-in. shaft sizes. Ahlberg Bearing Co., 3025 West 47th St., Chicago.

Centrifugal Pumps



Bearing housings of single-stage centrifugal pumps, where peripheral speeds are not excessive, have been designed incorporating single-row, deep-groove-type, anti-friction ball bearings as standard equipment. Sleeve-type bearings may also be used in these housings. Design consists of single-row, deep-groove ball bearings on both ends of the pump in cast iron adapters arranged for grease lubrication. Locknuts on both ends of the shaft hold the bearings in place without resorting to press or shrink fits, it is said. Adapter inside the main housing acts as a double seal preventing grease from leaking out. Allis-Chalmers Mfg. Co., Milwaukee.

Air Release Valves

Air-release valves that consist of a valve and seat, a lever and a ball float inside a case, automatically rid pipe lines and

AMONG MEN WHO WANT MORE PUMP FOR LESS MONEY, SSUNITS ARE FIRST CHOICE!

ALLIS-CHALMERS SSUNIT PUMP, here shown pumping wort, is "first choice" of the chief engineer in this brewery . . . a man who knows the importance of getting high pumping efficiencies at low cost.

Real Dollar-Saving Performance . . . That's What Men Who Manage Plants Get With the Fast-Selling SSUnit Pump!

It's making news...this low-cost SSUnit Pump with extra-value features that give men, responsible for production in their plants, new lows in pumping costs!

Compact, husky design beats space waste . . . cuts maintenance costs! Bronze construction of the enclosed runner, wearing ring, and shaft sleeves means full protection against rust and excessive wear. Complete testing before delivery is your assurance that your SSUnit Pump can go to work for you the minute it is installed in your plant!

There's Full-Measure construction in the famous Lo-Maintenance Motor that drives the pump...the same Full-Measure Motor that has an outstanding record for standing up under conditions that many times wreck ordinary motors in a few weeks. No "buck-passing" . . . Allis-Chalmers accepts undivided responsibility for both motor and pump!

And the Allis-Chalmers engineering that originated the motor-coupled pump in 1926 is the same great engineering that designed and built the great Niagara Falls and Boulder Dam turbines!

These are plus features . . . plus features no other pump can give you. And they mean more gallons for less money!

Get the whole story of why hundreds of plants are switching to the new SSUnit Pump. Call the nearest district office or write direct to Allis-Chalmers.

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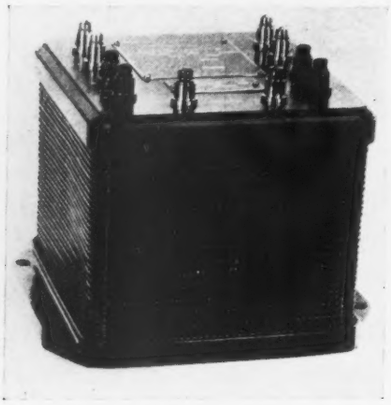
. . . 90 Years of Engineering Superiority Work for You When You Specify Allis-Chalmers!

CENTRIFUGAL PUMP DIVISION
ALLIS-CHALMERS
MILWAUKEE · WISCONSIN

other closed vessels of entrained air or other gas, it is claimed. In operation, the valves are placed at high points—the air centers—in the pipe line. Three types, applicable to water-heating systems, brine lines, water mains, are available. Standard model in 6 sizes from ½ to 2 in. for pressures up to 250 lb. per sq. in.; forged steel model in 3 sizes with pipe connections of ½, ¾, 1, 1¼, 1½, and 2 in. for pressures up to 1,000 lb. per sq. in.; ¾-in. size for maximum pressure of 150 lb. per sq. inch. V. D. Anderson Co., 1935 West 96th St., Cleveland.

Thermal Converter

"Thermoverter," using any potentiometer or D'Arsonval millivoltmeter as the measuring instrument, makes it possible to measure a.c. power in an individual circuit, to totalize a.c. power in a number of circuits, to telemeter a.c. power or



totalized load, it is claimed. It performs a proportional conversion from a.c. watts to d.c. millivolts when connected in an a.c. metering circuit. Power load may be expressed directly by a d.c. potential difference suited to transmission over considerable distance, and for totalization. Make-and-break contacts, field adjustments, and moving parts, have been eliminated. Time of response between a change of a.c. power load and development of proportional emf. in the Thermoverter is said to be less than ½ second. The Bristol Co., Waterbury, Conn.

Center-Control Truck

Type F-16 center-control fork truck, rated at 6,000 lb., has a 500 per cent overload, heavy-duty, and high-torque inclosed motor. Built either as a telescoping or non-telescoping truck for inside car work or high tiering of pallet loads in warehouses, it may be fitted with a 2-prong fork. The trail or rear axle carries the frame on a spring system which, it is claimed, provides 3-point support and assures floor contact for the trail and drive wheels. The trail-axle wheels are fitted with solid rubber tires and are steered by a horizontal back-geared hand wheel. Slip clutch provides protection against excessive overloads or accidental thrust of load forks under immovable objects. An overrun ratchet device protects hoist and chains if load forks are lowered against an obstruction. An electro-mechanical brake holds the load. Travel controller is self-returning to neutral and may be furnished hand or foot controlled and with brake feature for electric braking on ramps. Electric cutout controls fork carriage travel and tilt limits. The truck may be had with interchangeable lead or alkaline battery, or gas-electric unit. Elwell-Parker Electric Co., Cleveland.

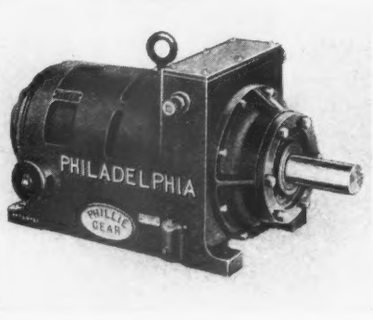
A.C. Generator

Self-voltage-regulating "Packaged" generator for producing a.c. power, ready for connection to the electric power load, is suitable for direct drive or belted drive by diesel, gas, or gasoline engines. It consists of a fabricated, all-steel generator of cool-running design; an exciter mounted on and V-belt driven by the generator, or direct-connected to the generator; and a generator-mounted voltage-control cabinet containing a voltage regulator and the generator voltmeter and ammeter. Switchboard is unnecessary. Leads from the generator can be run to the load through a wall-mounted or floor-mounted generator switch. Electric Machinery Mfg. Co., Minneapolis.

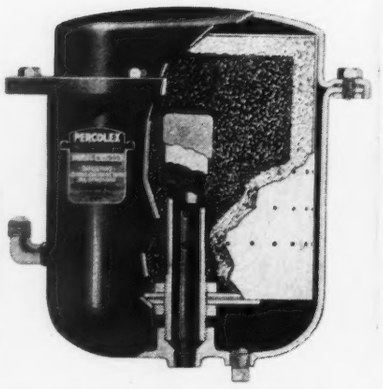
Modulating Valve

Throttling gas valve, a self-actuated temperature-controlled valve with a sensitive-fill, remote-bulb temperature element, operates as a combination "on-off" and throttling control to eliminate overshooting and undershooting, and is designed to eliminate all possibility of "blow-backs." The temperature-sensitive element, upon being heated or cooled within the throttling range, actuates a double-seated valve and proportions the flow of gas to the temperature demand. May be used with furnaces, linotype pots, ovens, oil heaters, die-casting machines. Three Models: 1224 has range of 100–300 deg. F.; 1225, range of 100–500 deg. F.; 1226, range of 300–600 deg. F. Gas capacity: 300 cu.ft. per hr. with a ¾-in. pipe, 450 cu.ft. per hr. with a 1-in. pipe. Wheelco Instruments Co., 1929–33 South Halsted St., Chicago.

Motor Reducer



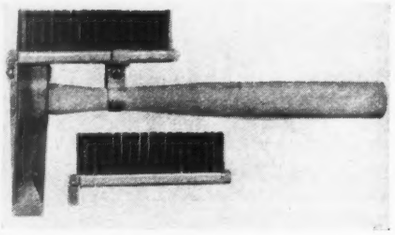
Motor of the "PlaneTorque MotoReduceR," for protection of agitators, mixers, conveyors, or other equipment that might jam or become overloaded, shuts off automatically and instantly, it is said, when the load exceeds a predetermined value. Upon removal of the load, the motor is ready to start without resetting. The reducers can be supplied for horizontal or vertical drives, for clockwise or counterclockwise rotation, or for both where reversing service is desired. Philadelphia Gear Works, Erie Ave. & G St., Philadelphia.



Oil Filters

"Percolex" oil filters, for internal combustion engines (gas, gasoline, or diesel), necessitate passage of oil through several filtering agents: perforations in the removable cartridge shell; compressed waste that absorbs dust, dirt, and sludge; "earths" that absorb water and acids; protective and filtering product; fabric filtering agent that stops abrasives; fine mesh metal screen. Sump below the cartridge traps dust, dirt, and sludge. Cartridge may be changed when an excess quantity of impurities appears in the oil. The Dushane Co., Inc., 1516 South Wabash Ave., Chicago.

Welders' Chipper



Triplex welders' chipper consists of a drop-forged steel chipping hammer with hardwood handle and a heavy-duty wire brush mounted on the topside, so that the same tool can both chip off slag on top of weld metal and brush it away. The brushes are replaceable. St. Pierre Chain Corp., 54 Frank St., Worcester, Mass.

Dust Determination Aid

"Microprojector," for counting and size-estimating of dust particles, can be used to tell whether dust collectors and ventilation systems perform satisfactorily. It projects an image of a microscope's field upon a ruled vertical translucent screen; provides a magnification of 1,000 diameters for counting and 10,000 diameters for particle-size determination; facilitates counting of concentrated samples without dilution, helps distinguish dust particles from pits and bubbles. It consists of an automatic-feed carbon arc lamp—the light from which is reflected by the microscope's mirror up through the field to a right-angle projection prism fitted above the eyepiece, and leatherette bellows between the prism and a square ruled screen. Remote controls facilitate focusing of mi-

Starting away with a bulky load on the handy Rollaway Skid... Hyatt equipped... product of the **YALE & TOWNE MFG. CO.**, Philadelphia, Penna.

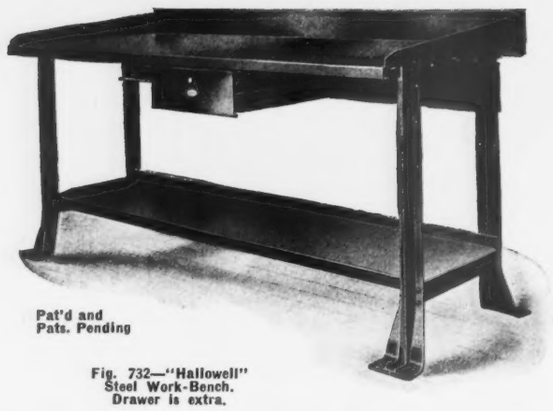
HYATTS ARE *Right* IN THE CENTER OF ACTION

ACTION *CENTERS* AT THE BEARING POINTS, where power meets load—where you must guard against friction, waste, wear, maintenance, replacements, shut-downs. And here, where the battle for efficiency is fought, equipment builders accept Hyatt Roller Bearings with utmost confidence.

Confidence enriched by years of successful experience with these better bearings...confidence in correct bearing design, precision manufacture, sturdy construction, and sound application...confidence that in the centers of action Hyatts will always serve well and long. Hyatt Bearings Division, General Motors Sales Corporation, Harrison, N. J., Chicago, Pittsburgh, Detroit and San Francisco.

HYATT ROLLER BEARINGS

NO RIVETS
NO SCREWS
NO SEAMS



Pat'd and Pats. Pending

Fig. 732—"Hallowell" Steel Work-Bench. Drawer is extra.

—to mar the Smooth Working Surface of "HALLOWELL" STEEL WORK-BENCHES

Smoothness is permanently assured when you equip with "Hallowell" Steel Work-Benches. No danger of the tops splitting, splintering or cracking . . . no chance for them to get oil soaked, either. They're sturdy enough for heavy work . . . slick enough for precision work.

"Hallowell" Benches are of a standardized construction, easily disassembled for moving to new shop locations and there set up strong, firm and smooth as ever . . . so different from the ordinary wooden bench that becomes kindling wood when knocked apart.

Two or more "Hallowell" Benches can be easily joined end to end where a long continuous working surface is needed.

There are 1368 bench combinations for you to choose from so you're sure to be suited exactly. Priced right, shipped from stock without delay. Get our catalog that gives you all the facts.

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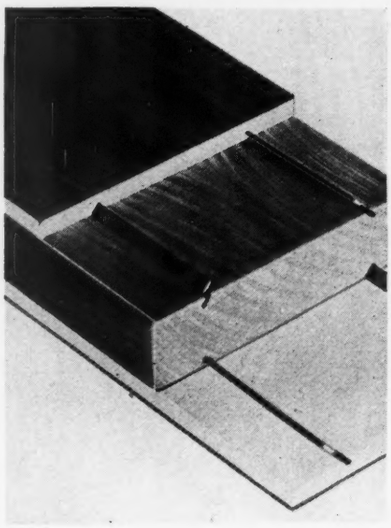
croscope and operation of the mechanical stage by the observer at the screen. Mine Safety Appliances Co., Braddock, Thomas & Meade Sts., Pittsburgh.

Spline Lock

Provides a means of joining 2 pieces of wood, metal, tile, plastics, or any combination, through the use of 2 splines or keys made of metal, wood or plastic, inserted in matched grooves. It is claimed that this method produces a joint stronger than that obtained by ordinary means. With glued joints it is said that use of the spline lock eliminates need for clamping parts rigidly while the glue sets. By properly proportioning the thickness of the splines, fric-



tion and tension between the 2 pieces joined may be increased until the pieces become immovable. Or, the splines may be used as a track or groove to insure easy sliding, as in table drawers or windows. Rights to use the spline lock are being granted to manufacturers on a license basis. Power-driven equipment, as well as hand tools, for cutting spline grooves have been developed and are obtainable on lease from the licensor. The Doughty Marketing Corp., 342 Madison Ave., New York.

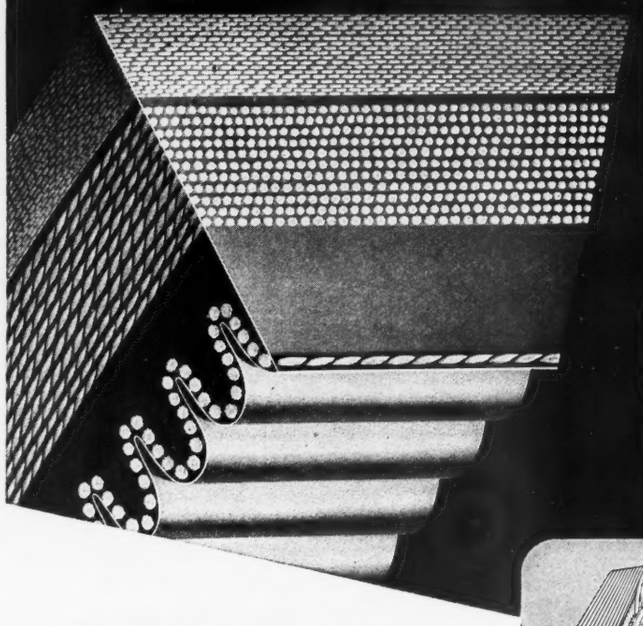
Fish Tape, Reel, and Puller

Combination fish tape, reel, and puller is 8½ in. in diameter, less than ¾ in. wide. It includes 50 ft. of ⅛ by 0.06-in. tape and weighs 30 ounces. With it wire can be pulled through conduit in one operation; tape is held securely in the reel so that it cannot spring around and touch live wires. Ideal Commutator Dresser Co., 1416 Park Ave., Sycamore, Ill.

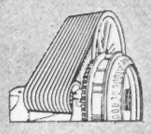
Oil Burner

Retaining the basic principles of the rotary burner, this unit is combined with an integrally driven oil pump and control devices. Although it is primarily for use in burning light oils, it is furnished with built-in equipment for handling and treating heavy grades as well. When used for heavy oils, equipment for temperature control must be installed. Gas-electric ignition comprises standard equipment on a.c. powered burners. The ignition assembly is a separate unit and is detachable from the

For Smooth Dependable Power

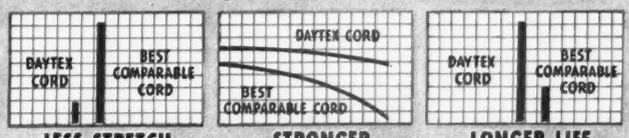


DEMAND DAYTON Super-Flex COG-BELTS With DAYTEX CORD



FIELD EXPERIENCE CONFIRMS THESE LABORATORY TESTS WHICH PROVE THE OUTSTANDING SUPERIORITY OF DAYTEX CORD

Charts Show Laboratory Tests of Daytex Process Cord Versus Best Comparable Cord *Not* Daytex Processed



LESS STRETCH *Stretch test-cords.*

STRONGER *Tensile test-cords.*

LONGER LIFE *Belt flexing test.*

SEVEN YEARS RESEARCH—Dayton's famed technical laboratories spent seven years of tireless research to develop these new Super-Flex Dayton Cog-Belts with Daytex Cords in their neutral axis section.

STRONGER, MORE COMPACT—Daytex Cord is made from the highest grade long staple, hard-bodied cotton. A bonding compacting agent removes, during the process of manufacture, the non-essential oils and waxes from the individual fibres. As a result, these fibers interlock and form a stronger and more compact cord.

22% LESS DIAMETER—Due to Daytex Processing, this Super-Flex Cord averages 22% less diameter. It has greater tensile strength. It stands up under constant high speed flexing. Furthermore, it has lower stretch and, due to interlocked fibres, has minimum tendency to become lifeless.

COOLER RUNNING—because highly developed rubber compounds are forced into and around each individual cord this denser Daytex Cord is made by patented Latexing and Calender Processes, which have been pioneered and constantly improved by Dayton for 19 years.

SMOOTH, DEPENDABLE POWER—because of their outstanding basic design, Super-Flex Dayton V-Belts with die cut sides have greater gripping power—the highest coefficient of friction of any belt. They are built to bend with patented cog construction. They assure you greater output of smooth power at lower cost. Call your local Dayton distributor or write for catalogs and data.

THE DAYTON RUBBER MFG. CO.
DAYTON, OHIO

Super-Flex
Dayton
COG-BELT DRIVES
WITH DAYTEX CORD

MADE BY THE WORLD'S LARGEST D MANUFACTURER OF V-BELTS

JOE, YOU'RE NOT LOOKING SO GOOD LATELY

"No, Cora, I have been feeling rotten. I think it's those fumes at the plant."

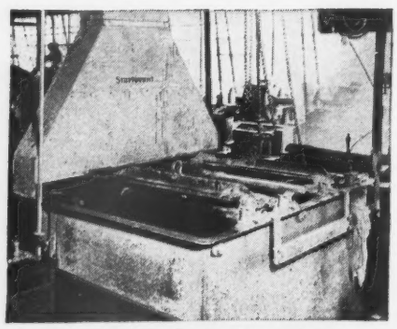
A HEALTH hazard such as this calls for *action.* Delay is likely to result in sad and costly consequences.

No matter whether your problem is one of removing fumes, dust, steam, or excess heat—Sturtevant can design a system for you which will effectively remedy the trouble.

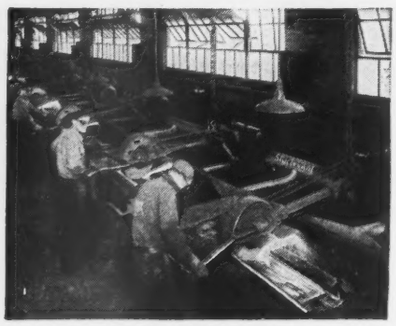
Sturtevant Dust and Fume Removal Systems offer you many advantages. They assure you of a system exactly suited to your particular requirements—skilfully engineered—backed up by over 75 years of air engineering experience.

Write, briefly explaining your problem, and your inquiry will receive immediate attention.

B. F. STURTEVANT COMPANY
Hyde Park, BOSTON, MASS. *Branches in 40 Cities*
B. F. Sturtevant Company of Canada, Ltd.
Galt, Toronto, Montreal



Sturtevant Exhaust System for cyanide tank.



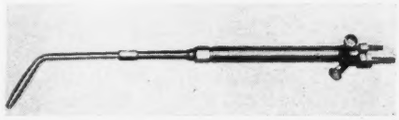
Sturtevant Grinder Exhaust System for carrying off emery and steel dust from grinding operations.

Sturtevant
REG. U. S. PAT. OFF.
Puts Air to Work

FOR DUST AND FUME REMOVAL

burner to facilitate adjustments. Control may be from a temperature-limit source (thermostat or aquastat) or from a pressure control operating between definite settings or limits. It may be supplemented by control from a source sensitive to variable increments in the demand. The relay operates in conjunction with a stack-mounted type of combustion safety switch. The motor frame is fully inclosed. It can be supplied for operation on standard voltages, single-phase or polyphase a.c., and for d.c. Todd Combustion Equipment, Inc., 601 West 26th St., New York.

Welding and Heating Blowpipe



Type W-26 heavy-duty welding blowpipe, for welding and heating ranges above the ordinary, delivers large amounts of heat to localized areas. It finds application in fabrication of tanks and pressure vessels, manufacture of locomotive boilers, straightening and bending of ship plate, wrinkle-bending of large-diameter pipe, and some flame-hardening operations. Extensions for the welding head are available for extra-heavy work. The Linde Air Products Co., 205 East 42d St., New York.

Flexible-Shaft Tools

Line of flexible-shaft tools, known as the Stow Juniors, are for grinding, polishing, buffing, rubbing, wire brushing, sanding, filing and drilling operations. Each model consists of a motor, extension cord and plug, flexible shaft and clamp spindle mounted on a metal four-caster pedestal with adjustable height, and tool tray. Connection can be made with any light socket. Motors of ¼, 1/3, or ½ hp. with speeds of either 1,725 or 3,450 r.p.m. are available. The ¼-hp. tool has a ⅜-in. flexible

shaft 5 ft. long with maximum wheel capacity 4x1 in., and maximum drilling capacity of ¼ inch. The 1/3- and ½-hp. tools have a shaft ½ in. by 6 ft., maximum wheel capacity of 6x1 in., maximum drilling capacity of ⅜ inches. Stow Mfg. Co., Inc., Binghamton, N. Y.

Graduate-Type Relay

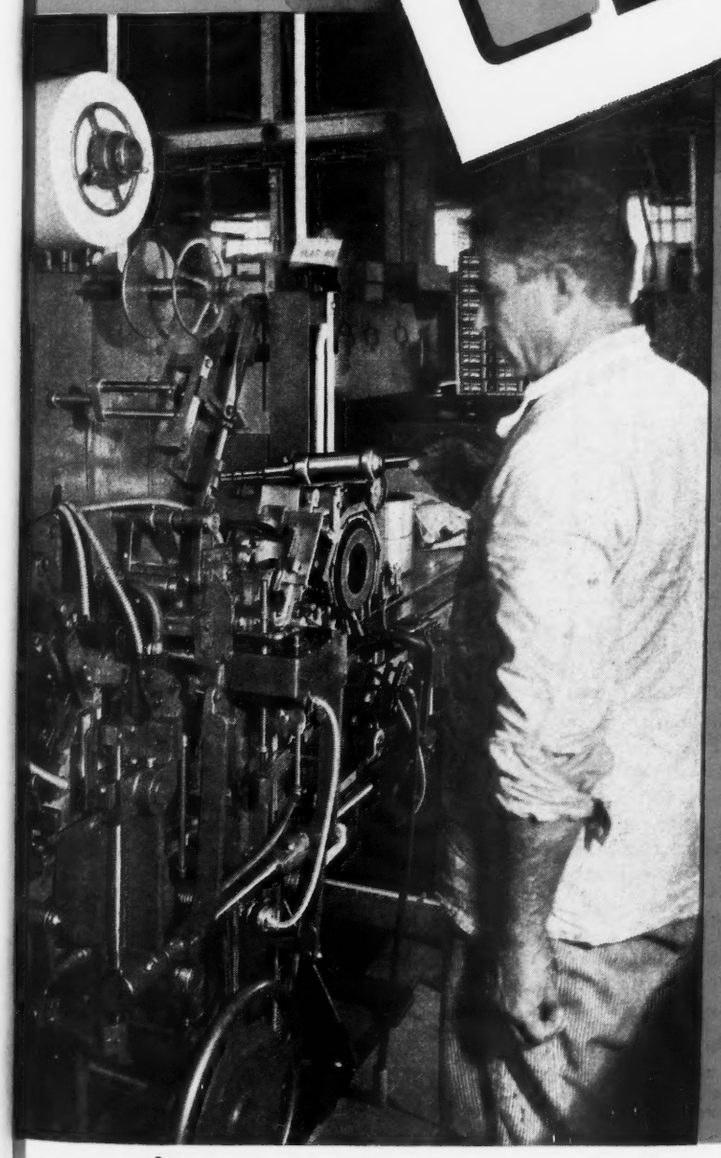
Type R095A "Grad-U-Relay" transmits control pressure in air line leading to it from a controlling device, to a greater number of control motors or valves than the controlling device is able to operate. Of

"ALEMITE EQUIPMENT IS FAST, SAFE, ECONOMICAL...

BUT ABOVE ALL, IT'S

CLEAN!

SAY LIFE-SAVERS, INC.



☆

Saves 16 Labor-Hours per Week!

INADEQUATE lubrication of a single bearing on the machines that make and wrap Life Savers *could result in costly repairs and expensive production delays.* On the other hand, one drop of oil on a package of Life-Savers wouldn't improve the flavor. So Life-Savers, Inc., use Alemite Lubrication Equipment *to keep machines operating at peak efficiency*—and *to keep their product CLEAN!* Lubricant goes *into* bearings—not onto the product!

Time-saving is an important reason for Life-Savers' enthusiasm over Alemite Equipment. They say it *saves them sixteen labor-hours per week* in lubrication time. The wrapping machine shown in the photograph, for instance, used to require daily oiling—now gets lubricant from an Alemite Gun once in two weeks!

There is an Alemite System, power or manually operated, *which can show similar savings* in your plant. To avoid contamination of machines and products—to speed the exacting job of lubrication—to safeguard machines and maintain production—put Alemite Guns on the job. Write today for our latest catalog!

ALEMITE

REG. U. S. PAT. OFF.

A Division of Stewart-Warner Corporation
1870 Diversey Parkway, Chicago, Illinois

Stewart-Warner-Alemite Corporation of Canada, Ltd., Belleville, Ontario

WORLD'S LARGEST MANUFACTURER OF LUBRICATION PRODUCTS

Alemite Electric Power Gun Model 6190

Holds 25 lbs. of plastic lubricant; delivers 12 oz. per minute under pressure of 4500 to 5000 lbs. per sq. in.; heavy duty universal electric motor; easily portable; complete with hose and cord.

Alemite Filler Tank Model 6425

Used to refill hand guns in Life-Saver plant. Holds 35 lbs. lubricant. Pumps 1 pound to each 7 strokes. Permits easy, fast, clean loading of Alemite Hand Guns without exposing lubricant to contamination.

Alemite "Rock Crusher" Gun Model 6524

Exclusive patented helix arm and worm positively prevents air pockets. Holds 40 lbs. lubricant—fibrous, plastic, or viscous; develops pressure of 5000 lbs. per sq. in. Easily portable.

Protect Your Workers with MORTON'S SALT TABLETS

Heat-Fag is real — an unseen but powerful force that rides every hot wave . . . a force that costs industry thousands of dollars each year. For, hot days and heavy work make men sweat — and, unless the salt that's sweated out of their bodies is replaced, Heat-Fag takes its toll, production sags and profits suffer. This fact is known by medical men everywhere and by safety directors, executives and plant superintendents.

Prevent HEAT-FAG in Your Plant

Place Morton's Salt Tablet dispensers at drinking fountains. These modern, sanitary dispensers represent the most efficient and economical way to provide workers with salt. A single push of the lever dispenses one tablet at a time.

MORTON'S SALT TABLETS Dissolve in 50 Seconds

They are easy to take — dissolve quickly. Only the purest and most highly refined salt is used.

Anticipate the Hot Days Ahead

Install Morton's Dispensers and Salt Tablets in your plant now. Place your order today. Remember — a small investment now will pay big dividends in Heat-Fag protection. Shipment will be made promptly — prepaid.

Write for folder—"Heat-Fag"

MORTON SALT COMPANY
CHICAGO, ILLINOIS

the non-leak type, it feeds or bleeds air to or from pneumatic motors or valves when a change is required in their position. New type of cone-check valve, said to be self-seating and airtight, is used. Standard type operates so that a rise or fall in the control line pressure to the relay produces an equal rise or fall in the branch line pressure to the motors or valves beyond the relay. May be had in reverse-acting type that produces an equal and opposite change in the branch line pressure. Minneapolis-Honeywell Regulator Co., 2950 Fourth Ave. South, Minneapolis.

Welding Electrodes

BBB welding electrodes are said to have slower burning, and good arc control results in less "wandering." With the heat intensified at the point of weld, spread of high temperatures to adjacent areas is less. The electrodes feature ability to stand up at higher current densities, to give increased penetration, and to reduce electrode heat at and above the grip by confining the heat more closely to the welding point. Becker Brothers Carbon Co., 3450 South 52d Ave., Cicero, Ill.

Hackney Drums

Two-piece hackney drums, for sulphuric-acid and aqua-ammonia services, are constructed from two seamless shells welded together by a single circumferential weld at the mid-section. I-bar rolling hoops are attached by separate lugs welded to the wall of the drum. Chimes at top and bottom are reinforced separately to protect the head. The interior is finished so as to be

free from crevices. The sulphuric-acid drum is heat treated for corrosion resistance. The aqua-ammonia drum is not heat treated, but the interior is pacified so as to overcome possibility of discoloration of the ammonia. Both types are furnished in 55- and 110-gal. capacities. Pressed Steel Tank Co., Milwaukee.

Rubber Clutch

"Airflex" expanding and constricting rubber clutches, with multi-vaned surface, consisting of 3 or 4 parts, are said to be self-adjusting. Capacity, regulated by internal pressure, can be changed to conform to needs and conditions of use. Built of

WE HAVE TO CHASE THIS CUSTOMER ALL OVER 156,000 SQUARE MILES!

"If I give you our business," said Mr. Harry Y. Stebbins, Executive Vice-President of General American Precooling Corporation, Los Angeles, "will you agree to keep up with us?"

THAT WAS A BIG ORDER. Because General American Precooling has 24 mobile units—some gasoline, some Diesel, some electric—which roam the whole of California, servicing freight cars for perishable crops wherever the shipping season takes them.

One day Shell will find them with a Diesel unit in furnace-like 140° of the Imperial Valley. The next will find a gasoline unit in the foothills with cold weather at night and 110° in the daytime. They will be on railroad sidings, at packing sheds, out in the country or in the fruit- and vegetable-market districts of a city.

And while Mr. Stebbins is extremely complimentary about the quality of the even dozen Shell products he has used exclusively for 4 years, Shell service is even more important to him.

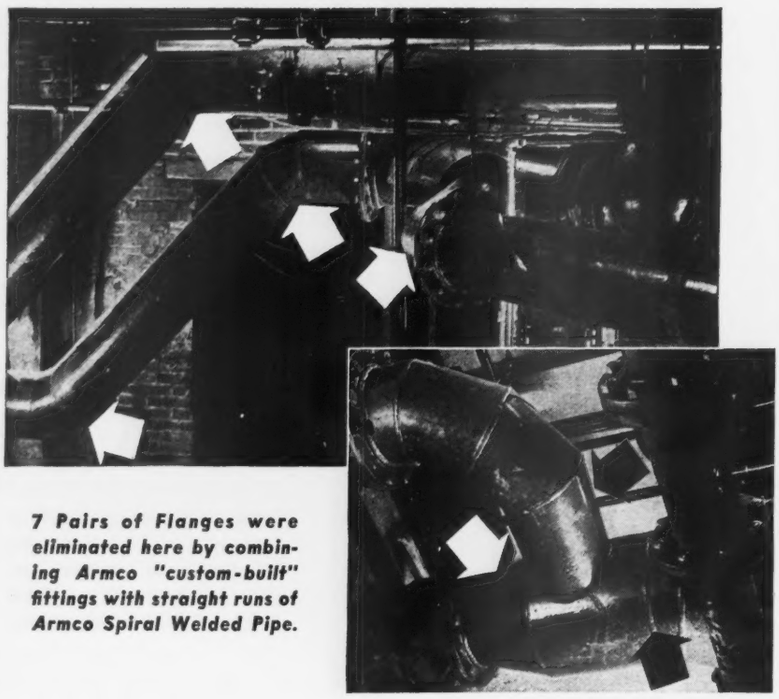
"We have tested your products both in the field and in the laboratory, and they save us many dollars," says Mr. Stebbins, "but when you realize that we contract to precool cars to exactly the right temperature at exactly the right time, you see what I mean by service. If your organization didn't get us supplies when and where we needed them, the profit per unit we would lose directly would not be a drop in the bucket compared to the damage to perishable food products such a failure would cause. We picked Shell in the first place because of your splendid and complete coverage of our territory."

Wherever you are—whatever your service problem—Shell is equipped to deliver the goods. Call your nearest Shell office and hand the Shell technical staff your toughest assignments.

SHELL

INDUSTRIAL LUBRICANTS

Look What You Save with ARMCO PIPE



7 Pairs of Flanges were eliminated here by combining Armco "custom-built" fittings with straight runs of Armco Spiral Welded Pipe.

• Study these pictures for a moment. Then check your own piping layouts to see how many flanges you can eliminate by redesigning with Armco "Spiral Welded." • Chances are, you can reduce costs up to 25 per cent because Armco Pipe and fittings are shop-fabricated to your exact measurements. This eliminates a pair of flanges at each bend, reduces unnecessary weight, and saves hours of tedious assembly. Fewer gaskets also mean fewer potential scources of leakage. And remember, you gain extra space in your mill because Armco Piping requires less clearance than heavy, bulky types. • Whatever your needs, you'll find Armco "Spiral Welded" amply strong; smooth inside for peak flow capacity. Besides, it assures long thrifty service because there are no threads to weaken the metal and invite corrosion. Diameters run from 6 to 36 inches; wall thicknesses from 7/64 to 1/2-inch, with a choice of base metals and optional coatings. Just mail your specifications to The American Rolling Mill Company, Pipe Sales Division, 450 Curtis Street, Middletown, Ohio.

ARMCO

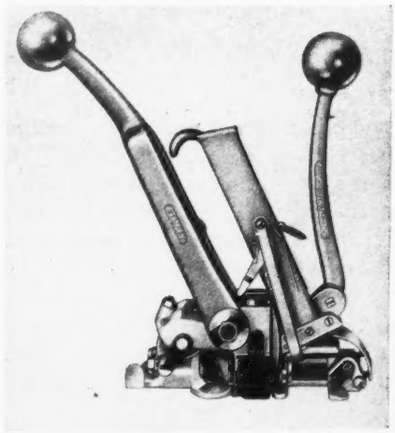
ARMCO

SPIRAL WELDED PIPE

heat-resisting rubber stock, the clutch incloses 6 plies of tire fabric. The tube is pre-molded and coated on inside to resist oil fumes that might accumulate in the compressor. For adhesion, rims are brass-plated and friction liners are riveted to brass plates which are vulcanized to the clutch gland. Two types of linings are used. Where excessive slippage is enccuntered, and where loads are to be picked up gradually, friction lining is recommended. Where a reasonable amount of slippage can be tolerated and engagements are not too frequent, a plain rubber squeegee-tread is used. The Fawick General Co., Akron.

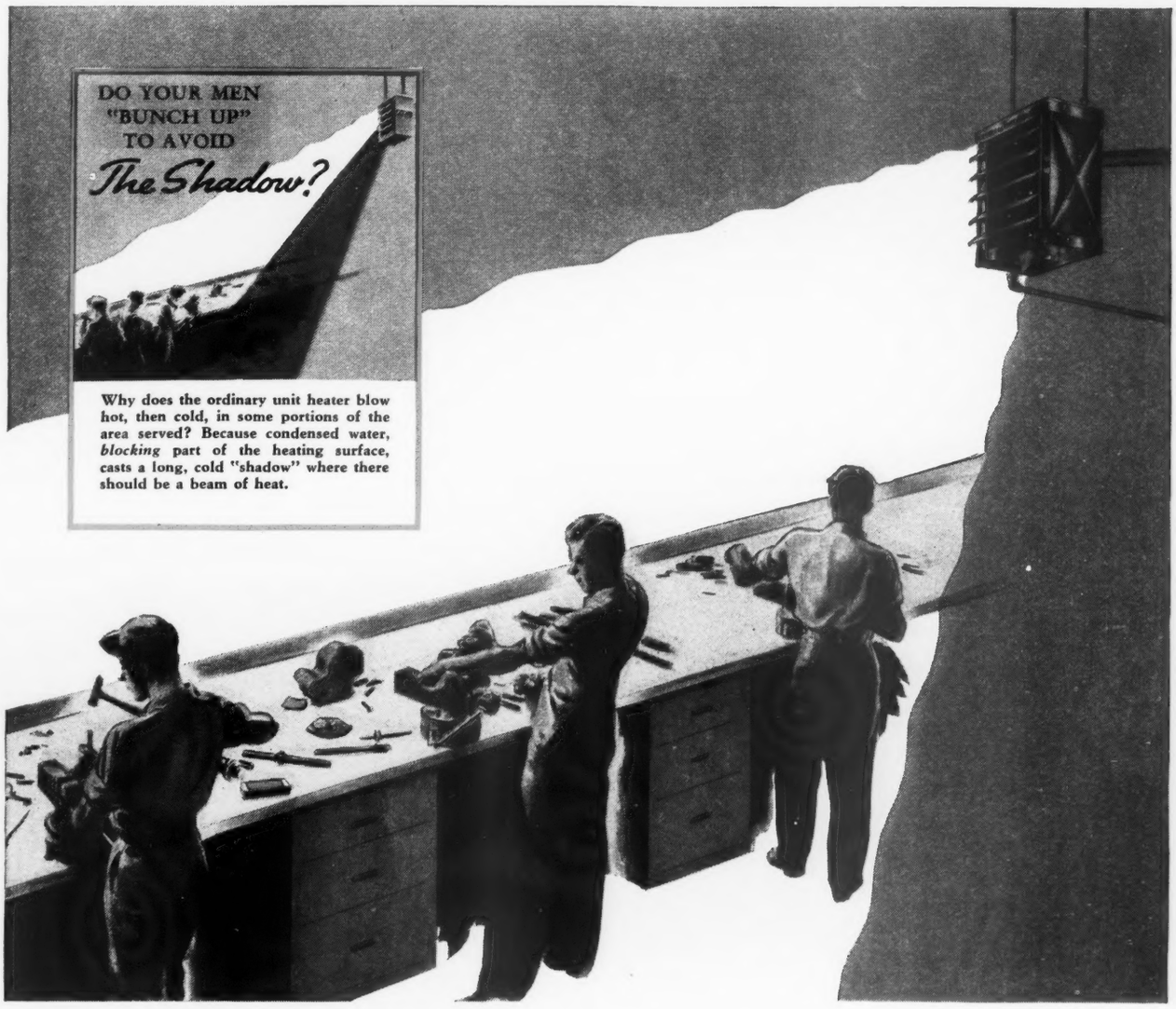
Strapping Tool

"Ace" strapping tool weighing 10 lb. 3 oz., for doing up shipping containers, is equipped with an automatic seal feed. Spring feed holds seals in position. The magazine is loaded with a clip of 100 seals available in sizes for ¼-, ⅜-, and ½-in. strapping. Operation takes 5 sec., it is claimed. After strapping is fed in automatically, a few pulls of the tension lever tightens the strapping and a forward push of a second lever cuts and seals the strapping. The Stanley Works, New Britain, Conn.



Lubricator

"Force-Feed" lubricator, capable of delivering from a fraction of a drop of oil to 10 drops per stroke at pressures of 2,000 lb. per sq. in., has been constructed to meet high-pressure bearing and stuffing box re-


DO YOUR MEN
"BUNCH UP"
TO AVOID
The Shadow?
Why does the ordinary unit heater blow hot, then cold, in some portions of the area served? Because condensed water, *blocking* part of the heating surface, casts a long, cold "shadow" where there should be a beam of heat.

GIVE THEM *"ELBOW ROOM"* WITH THERMOLIERS!

You want a *continuous* broad beam of heat over all the area where your men work. And that means *continuous* drainage of condensate – by Grinnell's exclusive Internal Cooling Leg, found in no other unit heater! It keeps *all* of the heater working *all* of the time – lowers fuel costs, eliminates "cold spots."

That's just one of the *14* points of superiority built into Thermoliers as a result of Grinnell's 50 years of heating experience. The full story is in the 48-page Thermolier Data Book, which gives complete description of Grinnell's 3 types and 30 sizes – for *every* heating need. Send for a copy. Grinnell Company, Inc., Executive Offices, Providence, R. I. Branch offices in principal cities.

SAVINGS:

Railway and Dock Shop saves – 35% in fuel . . . 75 tons of coal per season . . . with Thermoliers.

Manufacturer with over 50 plants averages overall Thermolier savings of 30% – $50 per day in one plant alone! And $5500 per year in another!

GRINNELL THERMOLIER

THE UNIT HEATER WITH 14 POINTS OF SUPERIORITY

Protect those narrow profit margins — with these *MILCOR* Ventilators and Skylights

Adequate ventilation and light helps you improve your operating efficiency . . .

Here's the important part Milcor Ventilators and Skylights play in increasing your production efficiency — in these days when you have to watch every nickel to squeeze out a profit:

Proper ventilation and light reduce fatigue and eye-strain among employes . . . cut down work hours lost due to accidents . . . increase safety. This is reflected in the speedy, economical output, maintained quality, and reduced spoilage of your product.

Employes appreciate your making your plant more pleasant to work in . . . making their operations easier to perform.

Milcor Ventilators are ruggedly built, remarkably efficient. Their great exhaust capacity insures a constant change of air . . . makes costly power-driven systems unnecessary in many instances.

Milcor Skylights are designed to give a maximum light area, with trouble-free service under all weather conditions.

Available in popular, standard designs, for large or small jobs. Special designs can be fabricated to your specifications. Milcor construction assures ease of installation, minimum maintenance costs, years of lasting service.

Call in the Milcor engineering staff to study your problems. Or, write today for complete information on Milcor Ventilators and Skylights.

F-78

Unit of the *MILCOR* System of fireproof construction

***MILCOR* STEEL COMPANY**

MILWAUKEE, WISCONSIN CANTON, OHIO

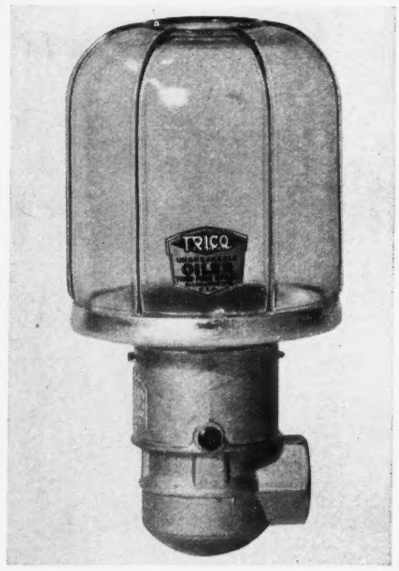
CHICAGO, ILL., KANSAS CITY, MO., LA CROSSE, WIS., ATLANTA, GA., NEW YORK, N. Y., ROCHESTER, N. Y., BALTIMORE, MD.

Sales Offices: Minneapolis, Minn., Little Rock, Ark., Dallas, Tex., Denver, Colo., Washington, D. C., Boston, Mass.

quirements, and to give service in high-atmospheric temperatures. Fine mesh screens are provided in the pump valve to filter oil delivered, and to keep dirt and foreign particles from entering the feed lines. Built-in sight feed is made of unbreakable, transparent plastic. Available in four types, from 1–60 feeds, based on the positive single-plunger principle with packed stuffing boxes and ball valves. Single- or multiple-feed assemblies with each valve independently adjusted. Hills-McCanna Co., 2349–59 Nelson St., Chicago.

Constant-Level Oilers

Constant-level oilers feature unbreakable crystal-clear reservoirs and adjustment oil-level features. They are designed to maintain automatically the proper oil level in ring or ball bearings, gear and pump housings. The reservoir is attached to the lower casting by a threaded spout and can be removed for cleaning and refilling. One fill-



ing, it is claimed, will lubricate a bearing for 3 or more months. Reinforcing ribs give the reservoir added strength. Available in 1-, 2-, 4-, and 8-oz. capacities with bottles interchangeable. Two styles for standard surge and high surge levels: side outlets only, side outlets and bottom outlets for bottom connection or for draining purposes. Trico Fuse Mfg. Co., Milwaukee.

Platform Trucks

"Electric Pony Express" platform truck, for light haulage in inter-department and factory transportation, weighs 870 lb. and operates with speeds up to 5 mi. per hr.—4 speeds forward and 4 reverse. Operator may face load or tow it behind him. Motor is controlled by a drum-type switch. Control column is located in front center of a 36x78-in. deck and allows space on each side for carrying bar stock and other merchandise longer than the truck platform. It is said to be able to turn completely in a 6-ft. radius. Safety features: hydraulic brakes on rear wheels, energizing switch under operator's foot, interlock on reversing switch connected with brake pedal making it necessary to stop before going into reverse, parking brake. Charging plug and receptacle make possible recharging

(Continued on page 96)

PRODUCTION COSTS GO DOWN WHEN YOU MAKE YOUR MACHINES MORE FLEXIBLE!

Your Machines Produce More . . . at Less Cost . . . When you Put the Allis-Chalmers Vari-Pitch Speed Changer on the Job! Get the Facts on How it Saves You Time, Power, Space, and Money!

Think what it would mean to you in improving your production schedule if you could run your machines at *exactly* the speed to give you best results . . . and be able to change that speed Up or Down — instantaneously — to suit changing conditions!

And yet that's what the Allis-Chalmers Vari-Pitch Speed Changer is doing for hundreds of industries! And that's what it can do for you!

This variable speed changer is NEW . . . and it gives you NEW production advantages . . . production advantages that have never before been available. For the Vari-Pitch Speed Changer has no steps requiring adjustments . . . no springs or gears to wear . . . no guesswork on the operator's part.

Saves Space . . . Time . . . Power!

You don't need to stop the machine to get the speed you want . . . you merely turn the hand wheel (or flick a switch) . . . and the change in speed is made to the smallest fraction of an rpm.

Not only that—the Vari-Pitch Speed Changer is extremely compact . . . takes only 1/4 to 1/3 the space used by bulkier transmissions. And through high efficiency operation, it makes big savings on power costs — an important factor that production men appreciate.

Find out about the Allis-Chalmers Vari-Pitch Speed Changer . . . how it operates to save you money . . . how it is built to give you years of profitable service. Get in touch with the transmission engineer in the Allis-Chalmers district office nearest you . . . or send for Bulletin 1266A.

BY SYNCHRONIZING A CONVEYOR and Shear used in cutting bats of steel wool, this Vari-Pitch Speed Changer provides exactly the right speed *at all times* . . . keeps production schedules steady . . . reduces production costs!

Available in sizes from 1 to 75 hp, ratios up to 3¾ to 1, maximum output speed 3500 rpm, the Vari-Pitch Speed Changer is a product of Allis-Chalmers, originators of the Texrope Drive and the Vari-Pitch Sheave.

Vari-Pitch Speed Changers • Texrope V-Belts • Duro-Brace Texsteel Sheaves • Vari-Pitch Sheaves • Standard Cast Iron Sheaves • Adjustable Pitch Diameter Texsteel Sheaves • 2-3-4 Combination Sheaves • Straitline Automatic Motor Bases • Oil Field Drilling Rigs

Belts by Goodrich

TEXROPE DIVISION

ALLIS-CHALMERS

MILWAUKEE · WISCONSIN

A1132

20 YEARS AT HARD LABOR!

Lo-Maintenance Motors Set Outstanding Low Cost Performance Record! Find Out How You Can Get Extra Dollar-for-Dollar Value . . . with Full Measure Constructed Lo-Maintenance Motors!

HERE'S THE LO-MAINTENANCE Motor that set a record of 20 years on the job with no time outs for repairs. And it's still going strong today!

If you are like executives who want the most from the equipment they buy . . . you've acquired the "long view." You want to know what your equipment will do . . . not only today . . . but for years to come!

Back in 1919, a large mid-western brewery bought an Allis-Chalmers Lo-Maintenance Motor. They figured it was a good investment . . . but they never realized the dividend that Lo-Maintenance Motor would pay them in staying on the job with no time-outs for repairs!

They didn't pamper that motor! They put it in a spot exposed to heat and moisture . . . hooked it to a pump . . . and put it to work 24 hours a day!

Not One Cent for Repairs!

Today—20 years later—here's the record! Not one cent has been spent for motor repairs! But that's not all! That Allis-Chalmers Lo-Maintenance Motor is doing as good a job for that brewery as the day it was installed!

That's why the chief engineer standardizes on Lo-Maintenance Motors in his plant. And that's why Lo-Maintenance Motors are fast becoming standard equipment in hundreds of other plants throughout the country.

You'll like the protection against breakdowns the high carbon steel frame and indestructible rotor and stator give you! The full Measure Construction with no skimping on materials that means longer life . . . less servicing . . . extra years of trouble-free service!

Get the whole story of the motor with more than just a rated horsepower . . . the motor that actually beats conditions that many times wreck ordinary motors! Call the trained production engineer in the Allis-Chalmers District Office near you. Let him show you how you can cut frequent time outs . . . reduce man hours lost due to motor failures . . . get longer motor life . . . with Allis-Chalmers Lo-Maintenance Motors!

. . . 90 Years of Engineering Superiority Work for You When You Specify Allis-Chalmers!

A1129

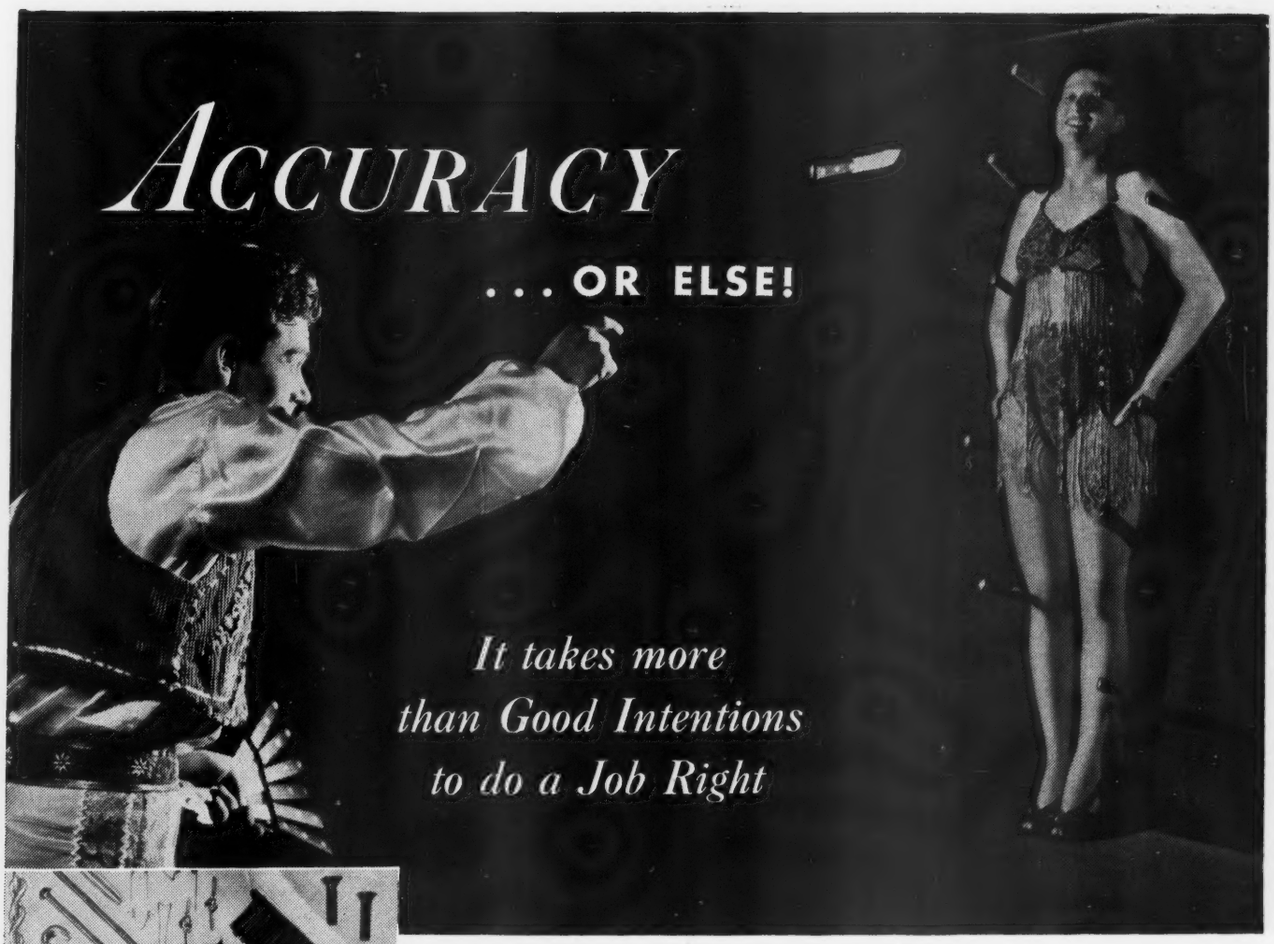
ELECTRICAL DIVISION

ALLIS-CHALMERS

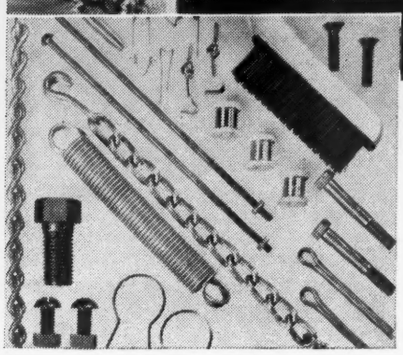
MILWAUKEE-WISCONSIN

ACCURACY

. . . OR ELSE!



It takes more than Good Intentions to do a Job Right



AND it takes more than good intentions to put quality into wire. We have been making wire for over 100 years. In that time we have built up a background of experience which has been of great value to our customers. For in that time we have fully developed all of the requirements for putting high quality into wire. You can count upon American Quality Wire to give the best results with the greatest economy.

American Quality Wire is carefully checked at every stage of its manufacture to assure that it is accurate in both metallurgical and physical properties. This product is produced in a complete range of sizes, grades, shapes and analyses. Our Sales Department and Engineering Staff will be glad to assist you in determining which wire will best serve your own particular requirements and our plants are strategically located so that deliveries can be made to meet your production schedule.

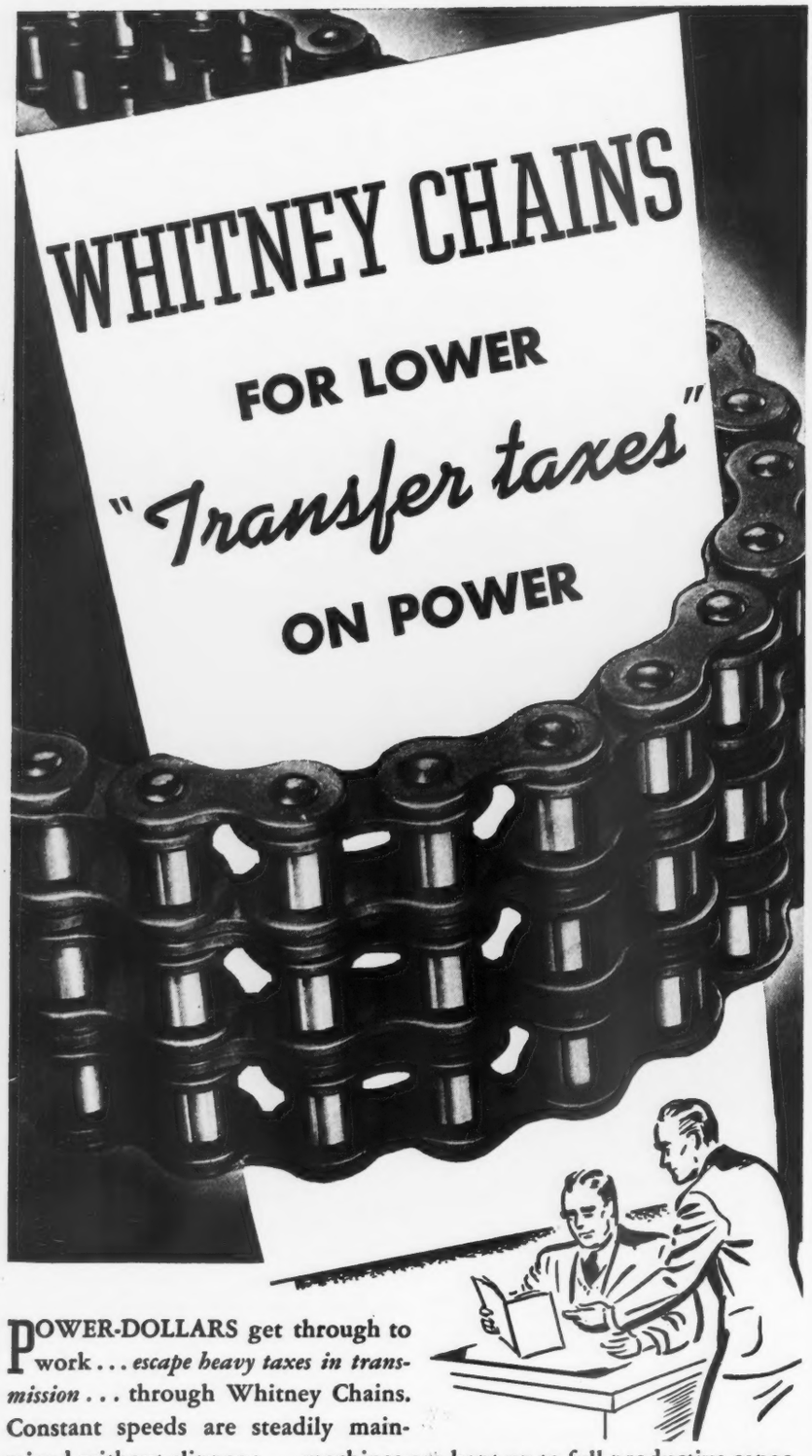
Premier Spring Wire · Weaving Wire · Pin Wire · Bolt, Rivet and Screw Wire · Broom and Brush Wire · Pinion Wire · Basic and Bessemer Screw Stock · Premier Tested Welding Wire · Flat Nut Stock · Hair Pin Wire · Mattress Wire · Music Spring Wire · Piano Wire · Amercut Cold Finished Steel Bars · Pump Rod Bars · Wool Wire · Wire Rods · Also U·S·S Stainless and Heat-Resisting Wires.

AMERICAN STEEL & WIRE COMPANY

Cleveland, Chicago and New York

Columbia Steel Company, San Francisco, *Pacific Coast Distributors* • United States Steel Products Company, New York, *Export Distributors*

UNITED STATES STEEL



POWER-DOLLARS get through to work . . . *escape heavy taxes in transmission* . . . through Whitney Chains. Constant speeds are steadily maintained without slippage . . . machines are kept up to full productive capacity. On every power drive application, Whitney provides the highest levels of chain performance, the lowest levels of cost. *You* may uncover new opportunities for increased profit and production . . . simply by sending this memorandum to your plant superintendent: "Check with Whitney Chain engineers on possible savings in power transmission and conveying."

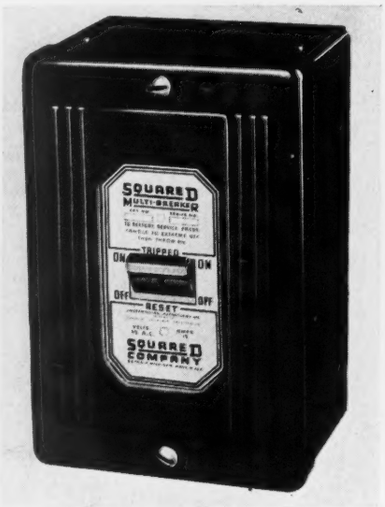
THE WHITNEY CHAIN & MANUFACTURING CO.
Hartford, Connecticut

(Continued from page 92)

of batteries without removing them from the truck. An ampere-hour meter shows reserve current remaining in the battery. Rocky Mountain Steel Products, Inc., 1347 Wall St., Los Angeles.

Circuit Breaker

Type MO Multi-breakeR provides a disconnecting switch and over-current protection for small motors. Comes in 15, 20, and 25-amp. sizes for 115/230-volt single- and two-pole applications. Unit is compact—6⅛x4x2⅞ in.—adapted to flush or surface mounting. No live parts are exposed. It is factory calibrated and sealed, and will interrupt the circuit under overload conditions but will not open the circuit during the brief periods of high in-rush current encountered in starting motors. Square D Co., Detroit.



Propeller-Type Blower

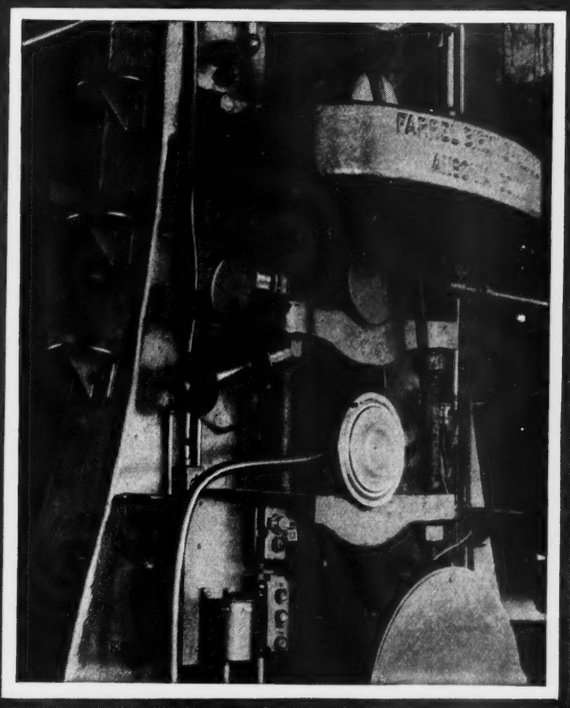
Propeller-type fan blower, with motor located on top of the blower housing and out of the air stream, can be used in moving air at high temperatures, or where the presence of acids or other elements might damage the motor. One side of the platform on which the motor rests is hinged. Lock bolts on the opposite side can be loosened for adjusting or replacing the belt. V-type belt, used in transmitting power from motor to fan shaft, is protected inside the blower by a steel guard. The propellers are said to be able to give high air deliveries against heavy back pressure. Available in 12 standard sizes with propellers from 18–48 in. long. Hartzell Propeller Fan Co., Piqua, Ohio.

Reset Control

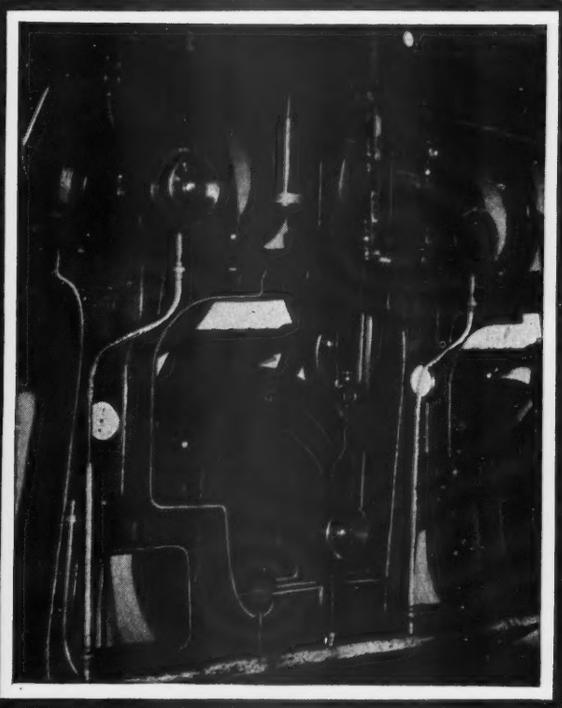
"Micromoto Reset," designed to compensate automatically for shifting of control point caused by changes in controlled process, finds application in fractionating towers, heat exchangers, continuous pasteurizers, barometric condensers, desuperheaters. It returns the controlled temperature or pressure to the controller set point after a load change occurs. Furnished with the "Controlograph," the Micromoto Reset is built into the Controlograph case mak-

COOLER BEARINGS LESS SLUDGE...

IN YOUR CIRCULATING SYSTEMS



Calender stack bearings run cooler when Texaco Ursa Oil is the lubricant. It is used throughout this mill, has been for more than 5 years.



Dryer roll bearings equipped with circulating oiling system. Texaco Ursa Oil is stable, assures clean oil lines and free flow of lubricant.

Service interruptions and shut-downs are fewer when machines are equipped with circulating oiling systems.

But a circulating system alone is not enough. Of equal importance is the oil used.

An assured success in circulating systems is Texaco Ursa Oil.

Using Texaco Ursa Oil, every bearing gets an ample supply of clean, cooling lubricant at all times. Texaco Ursa resists sludging and breakdown under high temperatures and pressures keeping feed lines clear and efficient.

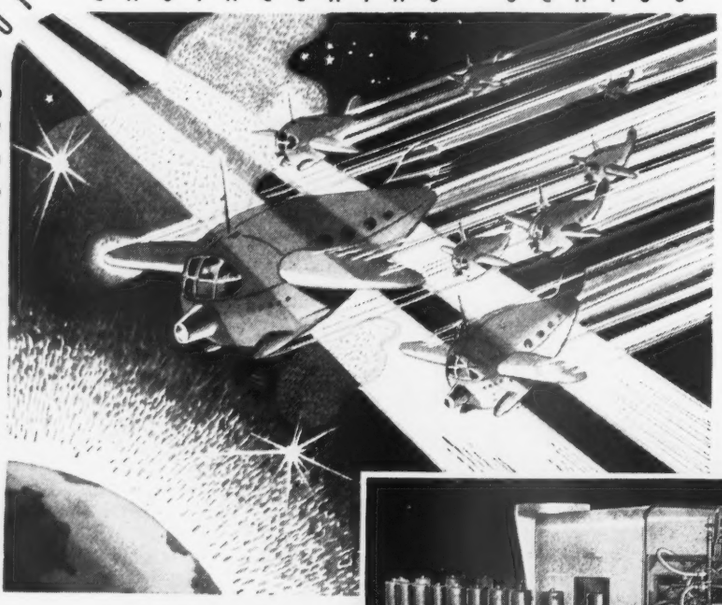
Lubrication engineers experienced in the selection and use of Texaco Ursa Oils are freely available to help you to better lubrication. For this engineering service, phone the nearest of our 2229 warehouses, or write:

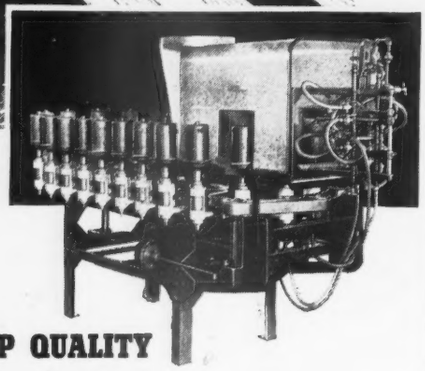
The Texas Company, 135 East 42nd Street, New York City, N. Y.

TEXACO Ursa Oils

PERFECTED LUBRICATION WITH CIRCULATING SYSTEMS

MODERN MIRACLES OF ENGINEERING GENIUS •





"MORE SPEED, REDUCE COSTS!" SAY MANUFACTURERS. "STEP UP QUALITY ON PRODUCT-FINISHING!" SAY BUYERS

MODERN DeVILBISS *Automatic* SPRAY-FINISHING EQUIPMENT WILL DO IT FOR YOU!

Engineering genius molds yesterday's fantastic dreams of speed into reality. Today, a modern manufacturing miracle speedily gives endless streams of products a durable, attractive finish—automatically. It's modern DeVilbiss Product-Finishing.

DeVilbiss Automatic Machines are years ahead in meeting manufacturers demands for higher speed—lower costs—for better-looking, longer-wearing finishes. They do the complete finishing job—from the application of the material to the ventilation of the finishing area. They handle products of many sizes and shapes—spray all materials—with unsurpassed efficiency and economy. They're as dependable as 50 years of spray engineering and manufacturing experience can make them!

Let us show you the amazing results of DeVilbiss Automatic Machines in finishing and coating. See what their profitable performance will do for you . . . Call DeVilbiss.

★ THE COMPLETE DeVILBISS LINE CONSISTS OF: Spray finishing equipment . . . Automatic coating machines . . . Tanks for spray materials . . . Spray booths and exhaust fans for vapor and dust elimination . . . Air regulators, cleaners and dusters . . . Air compressors . . . Respirators . . . Specialized hose for paint, air, water, gasoline, welding and pneumatic tools . . . Hose connections . . . Water and oil guns . . . Equipment to prevent offset in printing . . . Paint stripers . . . Medicinal atomizers . . . Perfume atomizers.

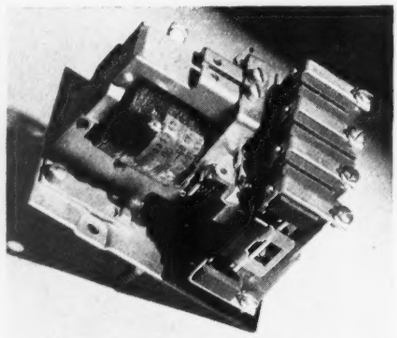
DeVILBISS SPRAY SYSTEMS

THE DeVILBISS COMPANY • TOLEDO, OHIO • U.S.A.

ing one unit, and is installed the same as a non-reset controller. It may be added to existing control applications. Where control instruments are of wide-throttling-range type, and it is necessary to have an automatic reset device, the Micromoto Reset can be installed without touching the control instrument, it is claimed. American Schaeffer & Budenberg Instrument Division of Manning, Maxwell & Moore, Inc., Bridgeport, Conn.

Multi-Pole Contactors

Multi-pole contactors, for use on machine-tool control and other built-in control applications, are assembled as complete units on steel bases for mounting on insulating or steel panels as part of the con-



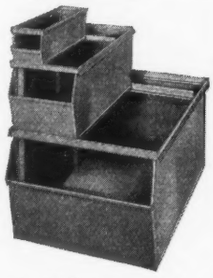
troller. The relays are arranged for front wiring of all connections. Rated at 10 amp., 500 volts maximum, they are available in 2- to 8-pole forms in any combination of normally open or closed contacts. Can be set up individually or in assemblies of 2 relays mechanically interlocked. Drop-out and pressure on normally closed contacts are obtained by use of heavy kick-out springs in addition to normal contact springs and gravity action. Identification labels show voltage and frequency. Westinghouse Electric & Mfg. Co., Dept. 7-N-20, East Pittsburgh.

Heater

"Unit Heatmaker," for factory drying processes as well as for use as a space heater, is a combination hopper-model automatic coal stoker, furnace, forced circulator, and humidifier that uses the principle of forced underfiring. A dual-rotor, air-circulating fan is used. Gases travel through 3 passes. Built in 2 sizes: 200

HERE'S HOW

Specialized Shop Containers



Designed for handling finished and unfinished parts for electric refrigerators, this special 3-box unit gives access to the contents of any box without disturbing the stack. The stack can be moved from place to place with an ordinary lift truck equipped with forks which contact the side rims of the lower box in the tier. Besides making very practical shop boxes, these containers also may be used as temporary sub-stockrooms—eliminating the necessity of emergency bins or shelving.

Helps Develop Employee Good Will

Industrial executives everywhere are discovering that the fine locker facilities they enjoy at the 19th hole are a fine investment for employee locker rooms at the plant. Illustration shows the attractive locker room in an Eastern Rayon Mill, equipped with roomy, well ventilated Lyon Single Tier Lockers.

Plate Pattern Storage

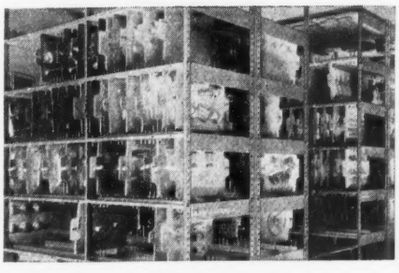


Illustration above shows the "Pin" System for the storage of plate patterns on Lyon Standard Steel Shelving. It provides excellent adjustability, protection and space economy.

The "Hanger-and-Rod" System, also applicable to Lyon Shelving, has proved equally satisfactory. In this system a hanger rod is suspended immediately below the shelf by means of two channel supporters bolted to the upright. Hangers are made from very heavy gauge wire, and are formed so that they will hold the plate in the proper position.

Modern Tool Crib Control Pays Big Dividends

The extent to which inadequate tool storage facilities and controls burden production costs is graphically illustrated by the experience of a large Midwestern manufacturer, who recently installed a modern system utilizing Lyon Storage Bins.

A survey disclosed that under the old system a sense of confusion constantly existed throughout the toolroom. In addition, inventory frequently was unbalanced, no records of tools available were kept, tool authority was not centralized, and the tool purchase program was inefficient and wasteful.

First Cost Seemed High — Savings in Eight Months Far Exceeded Total Investment

After the modern toolroom equipment and system of tool crib control had been in operation for eight months, a careful check-up was made to determine whether tangible benefits justified the $4,000 investment which the modernization program involved.

As the following figures disclose, the investment was found to have paid quick and substantial dividends . . . to say nothing of reduction of non-productive time and speeding up of production.

Inventory on gearing tools was cut from $4,228 to $2,239, on drills $9,000 to $7,000, on chasers from $6,000 to $3,500. Furthermore, perishable tool purchases were reduced to 42 per cent of those covering a similar period of the previous year, while total savings on purchases of tools and supplies throughout the period were in excess of $50,000. These items indicate the general trend, which cannot be entirely brought out in this brief article.

Toolroom Traffic Now at a Minimum

One of the miscellaneous benefits resulting from the new system, was the reduction of trips to the toolroom by workmen. It is estimated, for example, that under the present arrangement about 1,000 michrometer transactions a month were eliminated.

What's New?

The new Lyon Catalog illustrated above shows the most complete line of Steel Tool Storage Equipment ever built and describes the use of each unit for increasing toolroom efficiency and economy.

The Lyon Line of modernized tool storage equipment presented here includes units for the safe, convenient storage of all types and classes of small tools. Included also are methods of bar storage, shop equipment, enclosure panels, and tool and die storage.

Manufacturers interested in better protection of valuable tools, and more accessible storage that saves labor and floor space are invited to write for a free copy of this book.

LYON *Service*
STORAGE EQUIPMENT
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LYON METAL PRODUCTS, INCORPORATED
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Please send full details on:

☐ New Tool Storage Catalog; ☐ Steel Shop Boxes;
☐ Plate Pattern Storage; ☐ Lyon Steel Lockers.

Name _____

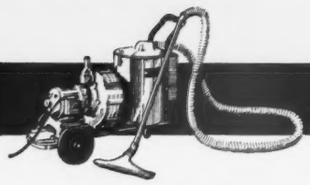
Address _____

City _____ *State* _____

DO YOU WANT—

1 A MUCH CLEANER PLANT..?
2 LOWER CLEANING COSTS..?
3 FREEDOM FROM DUST-DAMAGE?

Then look what INVINCIBLE INDUSTRIAL VACUUM CLEANERS *will do*



First of all, they *really clean* because dust and dirt is *removed,* not scattered around to resettle and damage equipment, machinery and product. The plant is virtually dust-free.

Invincibles clean all types of floors, from rough concrete to highly finished wood, and will handle practically any kind of dirt and litter except in the presence of water or oil.

Crowded, close quarters are no handicap to Invincible Vacuum Cleaners. Far from it. Invincibles clean wherever brooms can be used and a lot of places where brooms cannot reach.

Overhead cleaning of pipes, beams, walls, etc., become easy operations with Invincibles. Incidentally, with Invincibles on the job, these parts of the plant *stay clean* much longer.

Invincibles are invaluable for cleaning bins, shelving, motors, machinery, boiler tops, workbenches, conveyor belts, etc. If desired they may be used as efficient blowers.

Invincibles substantially decrease cleaning costs. One Invincible Operator often does the work of *three men* with brushes and brooms and saves an average of $2000 per year in payroll.

Last but not least, Invincibles seem virtually indestructible. Thousands of them have passed their twentieth year of continuous service. Before you say, "Vacuum cleaning is not practical for our plant," *talk to Invincible.*

INVINCIBLE VACUUM CLEANER MFG. CO. ... 440 DAVIS · DOVER, OHIO

Series is said to have an output rating of 50,000 B.t.u. per hr. when using coal with heat content of 12,000 B.t.u. per pound. Output of 400 Series is double that of the 200 Series. Hopper of 200 Series measures 27½x37½x44¾ in. and holds 200 lb. of coal. Hopper of 400 Series measures 36½x45½x51¾ in. and holds 350 lb. of coal. Iron Fireman Mfg. Co., Portland, Ore.

Merger

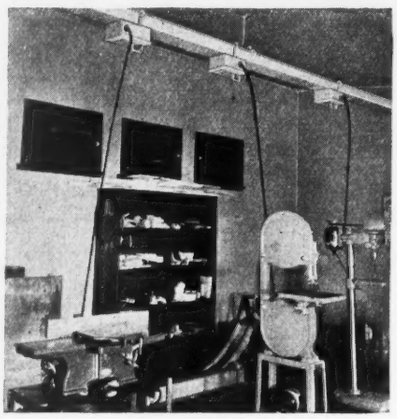
General Electric Company of Schenectady, N. Y., announces the merger of the General Electric Vapor Lamp Company of Hoboken, N. J., with the Incandescent Lamp Department of General Electric Company under the name, Lamp Department of the General Electric Company.

Recording Voltmeter

Model 522MS recording voltmeter, for survey work, uses a round chart. It is a portable light-weight instrument for indoor or outdoor service, is built into a weatherproof case, and is equipped with adjustable mounting legs for pole or wall mounting. A base is provided for setting it on the floor or table while in use. The Bristol Co., Waterbury, Conn.

Feeder Distribution System

"Flex-A-Power" No. 125 feeder distribution system, for use in small factories, workshops and garages where there are few machines, short runs, comparatively light connected load requirements, comes in 10-ft. units furnished with hangers.

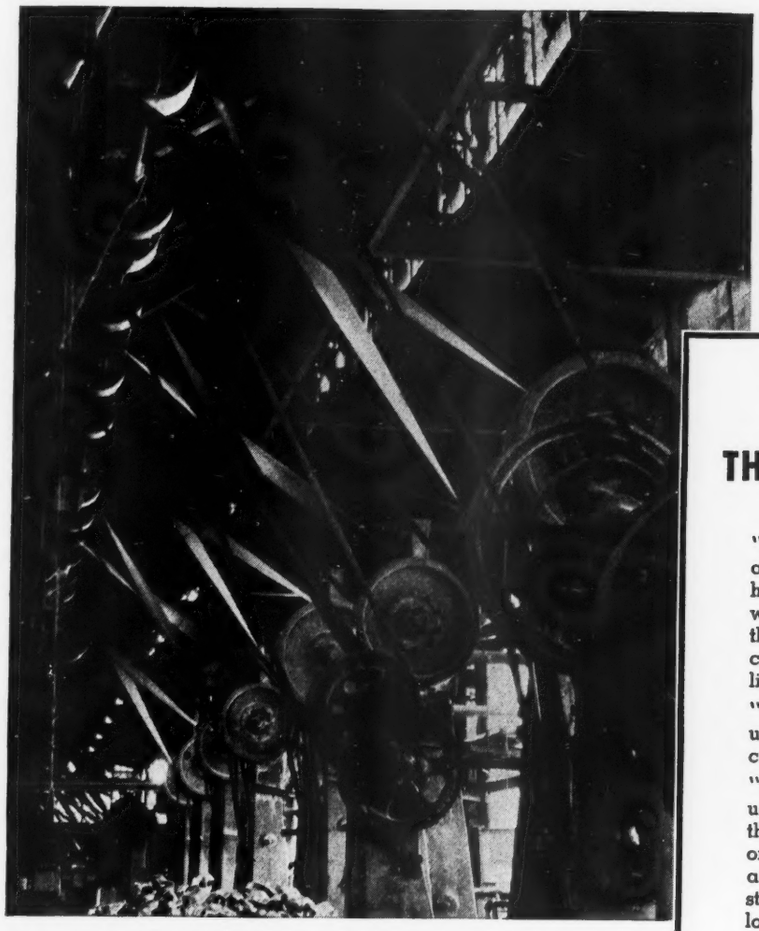


Available in 125-amp. capacity, 2- and 3-pole construction for 575 volts or less. Connections to machines can be made by plugging in with No. 125 "Flex-A-Plugs" at any point on 12-in. centers. The Flex-A-Plugs are available in 3 ratings—30-amp., 2- or 3-pole types, 250 volts; convertible 30- and 60-amp., 2- or 3-pole types, 250 and 575 volts. The Trumbull Electric Mfg. Co., Plainville, Conn.

Revolving Joints

Revolving flexible-ball joints provide free movement in all directions in connecting fixed piping to revolving drums or other revolving apparatus. Only the rotating sleeve revolves; it slides out and in to compensate for end play in the revolving drum. Double-ball design provides flexibility to take care of any slight misalignment or eccentricity

BREWER-TITCHNER *proves the superiority of* THERMOID TRANSMISSION BELTING



Photograph shows one group of four forging hammers, driven from a line shaft by 6-ply Thermoid Belts. Each hammer raises an intermittent load of 2,000 pounds. The 60 and 100 H.P. motors driving eight of these groups are coupled to the line shafts with 14" endless Thermoid Belts.

Another enthusiastic endorsement of Thermoid Transmission Belting's outstanding performance is contained in a report from the Brewer-Titchner Corporation's Forging Division in Cortland, N. Y. The unusual service delivered by these belts, driving eight groups of four forging hammers, is described in this report from the company's Plant Superintendent—

HERE'S THE REPORT OF THE PLANT SUPERINTENDENT

★

"We have tried several different types of belts and the Thermoid Belts are the only belts we have found that would hang to the steel pulleys without slipping. A very important feature about these belts is the fact that they can be run with considerable slack which of course means longer life to the belt and fasteners.

"Our maintenance cost is greatly reduced since using Thermoid Belts and loss of production time caused by belt trouble has been eliminated.

"The power savings we have experienced since using these belts is very gratifying. We attribute this saving to the fact that there is no slippage or stretching. We started using these belts about a year and a half ago and they are still going strong; therefore it is hard to estimate just how long they will last, as they show very little wear."

(Signed) Charles S. Card
Superintendent

Experiences like these are constantly demonstrating the operating efficiencies and economies enjoyed by countless users of Thermoid Industrial Rubber Products in every industry.

Thermoid's consistent, conscientious manufacturing policy . . . the specialized engineering service available for the solution of unusual problems . . . and the field cooperation of Thermoid's Distributors, all add up to a real opportunity for savings and better operations in your plant. Get in touch with your supply house today, or if you prefer write directly to us.

More than half a century of progressive engineering and product development.

THERMOID RUBBER, DIVISION OF THERMOID COMPANY, TRENTON, N. J.

Standard types of belting made by Thermoid:
Transmission Belting
Conveyor Belting
Multiple V Belts
Grader Belting
Canners' Belting
Bucket Elevator Belting

Thermoid

Standard types of hose made by Thermoid:
Air Hose
Water Hose
Steam Hose
Tank Truck Hose
Gasoline Hose
Suction Hose

BELTING · HOSE · PACKINGS · BRAKE LININGS

HE CAN'T GET IN HERE!

a FOOLPROOF BARRICADE With Window Shade Convenience

Here's the way to safeguard your property. The KINNEAR ROLLING GRILLE provides positive protection against intrusion without obstructing light, air, or vision. Its rugged network of solid steel bars and heavy steel links, secured in steel jamb-guides, make it remarkably strong. Coiling easily and compactly above the opening, it remains completely out of the way when not in use, yet is always ready to be instantly lowered and locked in place. Its efficient principle of operation saves maximum floor and wall space and assures lasting, carefree service. And to make it more widely applicable, the Kinnear Rolling Grille is built to fit individual requirements, in doorways, corridors, windows and many other types of openings . . . and is easy and economical to install.

MACHINE GUARDS

As a safety guard for heavier machinery where ready accessibility is required, a special adaptation of the Kinnear Rolling Grille is unsurpassed for effectiveness, convenience, and durability. It has solved the problem for a number of manufacturers. Submit your requirements for recommendations. There is no obligation.

The KINNEAR Mfg. Co.
1540-60 FIELDS AVENUE
COLUMBUS, OHIO
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FACTORIES: Columbus, Ohio, and San Francisco, Cal.

of movement. Combined universal movement permits self-alignment of the rotating sleeve to the revolving member. Special adapter is used when two different fluids are fed into the revolving drum, or when condensate is syphoned out through the same opening. A variety of sizes is available. Joint sizes correspond with standard pipe threads. Barco Mfg. Co., 1801–15 Winnemac Ave., Chicago.

Air Eliminator and By-Pass

No. 10 high-pressure air eliminator, used for automatic venting of unit heaters, pipe coils, dryers, under varying steam pressures

from 0–25 lb., is 2 in. in diameter, has a valve-seat opening $\frac{3}{16}$ in. in diameter. Top of air outlet is threaded for $\frac{1}{8}$-in. pipe connection for use as an automatic by-pass when desired, the eliminator automatically by-passing extra condensation that accumulates. Operating member closes eliminator at 212 deg. F. and keeps it closed until the temperature drops below 212 deg. when it automatically opens the eliminator. Gorton Heating Corp., Cranford, N. J.

Magnetic Separator

Cross-belt magnetic separator Type X consists of a magnet extending at right angles over the face of a belt conveyor and several inches over each side to provide an effective pull where it produces the greatest attraction. Used to extract tacks, pieces of wire, and other foreign particles from batches of bakery dough, from tobacco, tea, baking powder, spice. The Stearns Magnetic Mfg. Co., Milwaukee.

Hand Truck

Deck of steel-weld truck has a smooth surface; sides are turned down 3 in.; under side of platform has 7–10 channels depending on size and capacity of truck. Electric-welded construction is designed to produce a light-gage deck that won't sag or come apart under normal loads. Adaptable for use with the Clark lift jack, or for use as a factory truck with semi-steel or rubber-tired wheels equipped with roller bearings and pressure grease fittings. Casters are all-steel, double-row ball bearing with machine races. Standard sizes range from 24x48 to 40x72 inches. All Steel Welded Truck Corp., Rockford, Ill.

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the time proved corrosion resisting coating for metal surfaces. Gives longer, more complete protection at substantial savings in preparatory and application costs. Our representative will be glad to make estimates and recommendations.

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COLD WEATHER 60 DAYS AHEAD

BE READY *with* "Buffalo"

UNIT HEATERS

Breezo - Fin Unit Heater. 20 sizes. Tell us your needs.

Will your plant be ready to "turn on the steam" the first cold day—or will your heating system need overhauling?

With Buffalo quiet, well engineered Unit Heaters installed throughout your plant you can say "Goodbye" to heating troubles.

No more cold spots or hot spots. Correct working temperatures can be automatically maintained regardless of outside changes in weather.

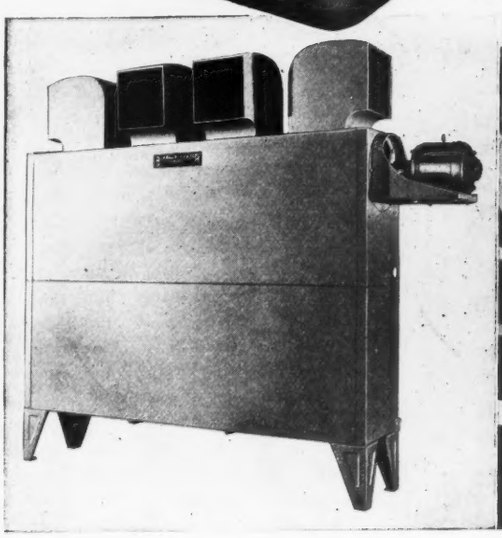
We can furnish sizes and types to exactly meet your individual requirements, all sturdy units rated according to I.U.H.A. Standards. Write for literature now. Prompt deliveries from stock.

BUFFALO FORGE COMPANY

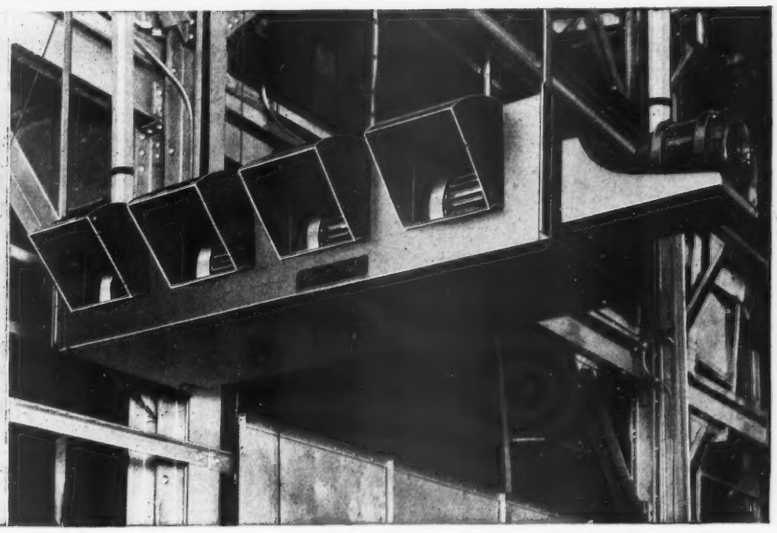
471 BROADWAY **BUFFALO, N. Y.**

Branch Engineering Offices in Principal Cities
Canadian Blower & Forge Co., Ltd., Kitchener, Ont.

Buffalo Floor Type Unit Heater for the larger working areas.



Buffalo Flat Suspended Type Unit Heater. Use it where floor space is not available.



Zenith Goes to One-Floor Flow

(Continued from page 35)

pacity, with space for 40 additional cars. This enables the plant to coordinate cabinet unloading with cabinet assembly operations. In most cases the cabinets are unloaded from the cars, immediately joined to their proper chassis, without intermediate storage or handling, and in many cases can be loaded back into the empty cars if the traffic situation happens to permit it. The switch engine comes in at noon, or oftener if required, and hauls away the cars loaded with finished goods; moves the empty cars to the loading end of the platform; spots the full cars of cabinets at the unloading end.

The plant executives try to eliminate handling—to keep an even flow of product through the plant. Even the dollies on which the cabinets and subsequently the finished products are moved, flow in a continuous motion. Moving to the shipping platform from the final packing process, the dolly is unloaded into the freight car. Then, empty, it is moved a few feet down the platform to the unloading point for cabinets, is loaded and moves to the final assembly line. Unloaded here, it is moved across a short distance to a point where the final assembly line loops around, and again receives a load of finished goods.

Thus far we have considered the continuous flow on the ground floor. Part of the plant has a second floor, which is only a small fraction of the total space. On this floor are grouped as many as possible of the non-production departments, laboratories, and offices. It contains enough floor space, however, so that there is some extra space which is temporarily used for production.

In this upstairs temporary production space are grouped two kinds of factory operations—light operations and export packing. The light manufacturing operations are those parts production jobs that employ only light, nonbulky materials. Here coils are wound, wire is cut, and various jobs involving a good deal of labor but little tonnage are handled. The materials for this production all move upward in the one freight elevator serving this floor, and this movement is so small that the elevator operator gives only a part of his time to running the elevator. At night the upstairs production is taken downstairs on hand trucks and spotted by the stockchasers at the stations along the assembly lines where it will be required next day.

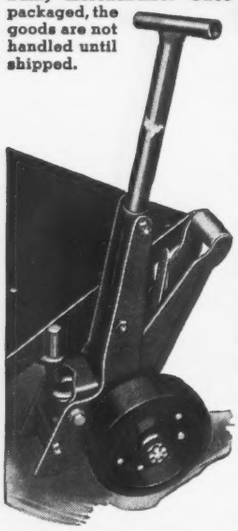
Compact models for export likewise come up on the elevator. Large export sets come up on a reversible slat conveyor from the shipping room. When the finished sets for export come off the final assembly line, they move to the shipping room. The shipping clerk places them on the slat conveyor which hoists them upstairs. The export packing department is directly above the shipping room. Practically all this upward movement is in the morning.

In the afternoon, sets that have been specially packed for export are moving downward into the shipping department. The conveyor we have just described operates with controls from both floors, and now moves downward only one position at a time. Thus the conveyor also serves for storage. When a set is packed upstairs, it is placed on the conveyor and moved one position downward. When it is full, the men downstairs see the packed sets coming, and the shipping clerk moves the conveyor downward a notch at a time and unloads it. By this method the workers downstairs are not forced to drop other work every time a set is packed upstairs. Instead, they allow them to accumulate and then handle them in a few minutes devoted exclusively to this purpose.

From this description of the layout

Mobilize HANDLING!

A row of loaded Colson Lift Jack platforms stacked with bulky merchandise. Once packaged, the goods are not handled until shipped.



BAGS, barrels, boxes, odd-shaped loads or what have you—all can be transported the mobile way with Colson Lift Jacks and Platforms. No extra pick-ups...no extra set downs...no extra handling. Goods can be moved at minimum cost.

Two simple units do the trick:

1. A platform or live skid with wheels on one end and legs on the other.

2. A twin-wheeled jack that engages the front end of the platform and converts it into a sturdy and easy-to-roll truck.

Multiply these units by the requirements of your plant and your materials are always completely mobile, while taking up but little or no more floor space than the area of the load.

Inexpensive, too

A very small investment will start this system for you. $150 will buy a lift jack and several platforms—no other equipment is needed. A Colson representative will gladly study your material handling requirements and show you how the Colson system saves money.

SEND FOR FREE BOOKLET

The essential facts of Colson Lift Jacks are explained in the booklet: "Colson System of Materials Handling." Write for a copy.

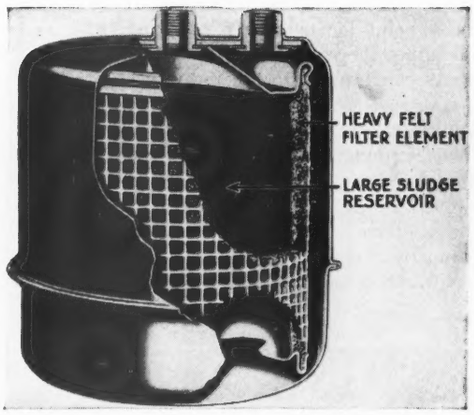
THE COLSON CORPORATION
3718 CEDAR STREET • ELYRIA, OHIO

COLSON LIFT JACK SYSTEM

A Better Oil Filter

with

CERTIFIED FELT



A HANDY GOVERNOR FILTER
Courtesy of Handy Governor Corp.

An outstanding protection for engines is provided by this filter made by the Handy Governor Corporation, who specify Felters Certified Felt due to its high quality and the natural filtering tendencies of first-grade wool felt . . . In other industries as well as in the automotive industry, Felters Certified Felts are playing an increasingly important role, as oil seals, wicks, oil filters, vibration isolators, sound absorbers and many other uses too numerous to mention. Improvements of felt for use in industry are steadily being made by the Felters Research Laboratory. Investigate felt for your use— we feel certain it will pay you.

Look For CERTIFIED FELT Made by The FELTERS COMPANY INC. Tested under the supervision of our own Laboratory *This Label*

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MILLS: Johnson City, New York • Millbury, Massachusetts • Jackson, Michigan

and production flow, it will be apparent that practically throughout Zenith has succeeded in causing the work to move forward continuously, to swing around an operation at a time, and to finish up at a point located for a minimum of handling thereafter.

As compared with the former Zenith plant, scattered among several separate buildings, the advantages are tremendous. Eliminated entirely are the delay and handling cost of backtracking the work. By working out a continuous flow, closer supervision with a great reduction in supervisory costs has consequently been attained.

You Can't Afford NOT to Replace Old Equipment

(Continued from page 42)

worked out on exactly the same basis. The diffeernce is accounted for entirely by the increased productivity of the new machine.

That increased productivity jumps that profit from 39 cents a day to $7.14 a day—an increase, believe it or not, of over 1,700 per cent.

Now you may say that this is an exaggerated case. You may feel that I have claimed too much for the new machine. You may be skeptical about the new machine's capacity to double production.

All right. Suppose that the new machine turns out only one-fourth more production than the old machine.

The return to the manufacturer from a day's output on the "man plus old machine" is $7.83 cost plus 39 cents net profit, or $8.22. A one-fourth increase in output would mean a one-fourth increase in its return. Adding one-fourth —$2.05—gives us $10.27 as the return for a day's output on the "man plus new machine." The cost of the "man plus new machine" is $9.30. The result is a net profit of 97 cents per day on the "man plus new machine" as contrasted to a net profit of 39 cents on the "man plus old machine."

This means that, even if the increased productivity of the new machine is only one-fourth over that of the old machine, the increase in net profit effected by the use of the new machine is 149 per cent.

The figures tell the story.

The farmers of this country may not be the world's best business men, but you will have to search a long way before you will find a man trying to plow a field with a blind mule and a lame horse. And I have noticed that a great many farmers stay in business for a long time.

Uniform Results . . . Lower Costs with Ryerson Certified Alloys

You can reduce failures—eliminate spoilage and get better results in less time with Ryerson Certified Alloy Steels. They are from selected heats of steel that meet an ideal specification—a "specification within a specification"—that assures uniform response to heat treatment.

All Ryerson Certified Alloys are analyzed and tested in advance. Special data sheets showing exact chemical analysis, grain size, cleanliness rating, and results of actual heat treatment tests, are prepared and sent with every shipment. You know exactly what you are getting. Your heat treater does not have to test. He takes no chances. Spoilage is eliminated and sound dependable jobs of high accuracy and uniformity are secured.

Ryerson has large and complete stocks of these selected identified alloy steels. They cost no more and quick shipment is assured.

Ryerson Certified Steels also include carbon, tool and stainless steels that meet definite quality standards. They offer many advantages to steel users. Let us tell you the complete story. Write for booklet.

Joseph T. Ryerson & Son, Inc. Plants at: Chicago, Milwaukee, St. Louis, Cincinnati, Detroit, Cleveland, Buffalo, Boston, Philadelphia, Jersey City.

RYERSON CERTIFIED STEELS

RYERSON

Tell Employees By News Letter

(Continued from page 43)

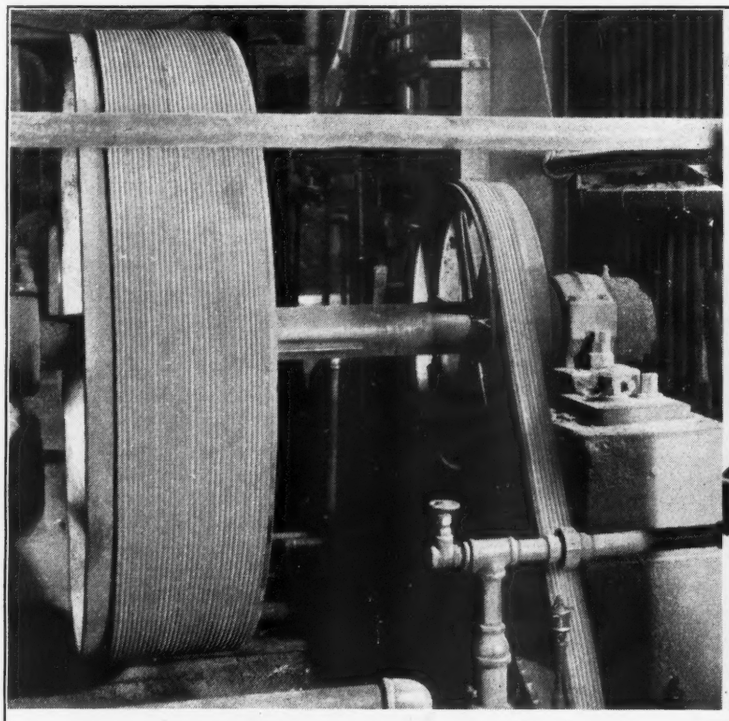
welcome pick-up in the Stainless Department.

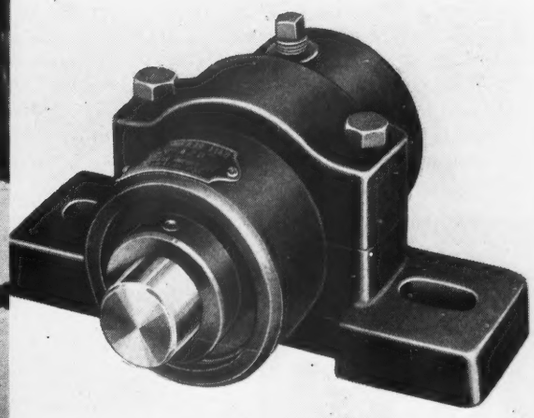
"*Eleven thousand dollars* a day is the average of wages and salaries being paid out to Butler ARMCO employees. The company pays social security taxes on this payroll amounting to about $440 per day, seven days a week. This daily payroll tax amounts to more money than is spent for coal at the Butler plant and is almost one-third of the daily cost of electricity for the entire plant. Employees pay about $110 daily for federal old age pension taxes.

"*Hospital insurance* applications are being received daily. ARMCO employees who want to get in on this plan must sign up before April 15. After that, too late. Application blanks provided and questions answered at the employment office, or ask your foreman or employee representative.

"We are proud that March was a no-accident month for the Butler plant.

"*The Wheel Works* produced 45 per cent more wheels in the past three

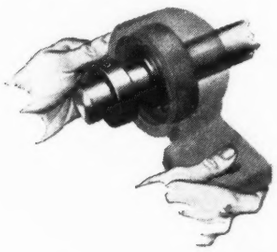


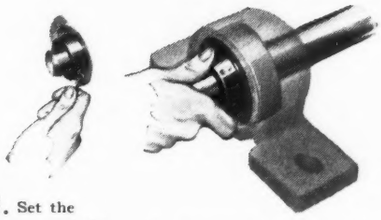


NINE YEARS' SERVICE TO DATE

Total "Vacation" . . . ONE WEEK!

1. Slip the Shaft through the bearing





3. Set the screw to hold the collar in place.

2. Engage the collar and lock it with a quarter turn.

The big 3 7/16" shaft in the picture above is the drive shaft of a 65 h.p. Diesel engine in the plant of the Janney Cylinder Co., Philadelphia. It turns 317 r.p.m. day and night, year after year, driving a 50 k.w. generator. There's plenty of dirt around, and zinc oxide fumes are in the air. *The outboard bearing is a Fafnir Double Ball Bearing Pillow Block*, and it has been there nearly nine years, with never a shutdown of more than 30 hours in any year. "Never a bit of trouble with the bearing," the company states. . . . Long, trouble-free service ranks with easy installation when industry gives reasons for choosing Fafnir Transmission Units * * Ball Bearings can help you make money when they combine the easy three-step installation, infrequent lubrication, and high load capacity provided by all Fafnir Units. Let your Fafnir distributor work with you in selecting the Ball Bearing Units best suited for your requirements. The Fafnir Bearing Company, New Britain, Conn.

FAFNIR BALL BEARINGS

THE BALANCED LINE · MOST COMPLETE IN AMERICA

months than in the first three months of 1938. That's a lot of wheels."

The letter is signed by the plant manager, as are the letters at the other plants.

Middletown's letters are longer as a rule, sometimes running to two full sheets. Part of this additional length, about half a page, is devoted to a section called "Bouquets and Brickbats," where customers' complaints or expressions of satisfaction about quality are listed, so that those men who had a part in fabricating the shipments may benefit by the comments.

A typical Middletown letter is too long to show here, but here is one issued late in June by the Ashland Division after the break in sheet prices:

"*The order book last week* received quite a few orders, enough to maintain our present rate of operations. Let's hope it continues long enough for everyone to get in some five-day weeks. As everyone knows by this time we are operating on orders that were sold at a reduced price. Men in this section of the country have examples right in front of them of what happens when a company's costs are higher than its selling price—every day when coming to work we pass close by a plant that is idle. There used to be a dozen blast furnaces in this section, but they have all been torn down. We want to avoid that thing, don't we? This is not a question of singing the blues, but rather it's just plain common sense to face the facts, and then everyone can do his part toward keeping our costs at rock bottom.

"*The steel industry* last week gained about what had been lost the week before and the rate of operations was at 55 per cent of capacity. The Ashland Division didn't do quite as well as the week before, but still our rate was considerably higher than the industry and it meant that last week the men on the payroll averaged 92 per cent of the time they are allowed to work under the restrictions of the Wages and Hours Bill and the Walsh-Healey Act.

"*First production order* for one of the bigger jobs on 1940 models is now coursing through our plant. The samples worked—if this order works it is usually followed by an order ten or fifteen times as big, which will mean more work for Ashland and that's what everyone wants. Quality from the blast furnace to the customer's press is extremely important to everyone in Ashland. It means more work later on.

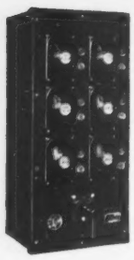
Tells of Records Set

"*Here's some good news from the front.* On one of the most difficult jobs in the stove business 5,000 parts were drawn with only four broken. They said this is not only by far the best ever, but the best they ever expect to get.

"*More records being hung up.* No. 2 sheet mill tonnage record for last week. No. 31 sheet mill broke its record again. No. 7 normalizer broke all-time weekly record last week. Someone must have told the men there the price of sheet iron is down, and this is their answer. Great work men—congratulations for answering the challenge—protecting all our jobs and making money for yourselves.

"*What is yield?* If your wife peels away a big part of the potato the yield will be low. If you buy berries and must throw away one-third, the yield is poor. And so it is in our business. If an order has too much scrap on it the yield is not so good. If there are cobbles and damaged sheets the yield goes down. Of course, there are items of yield other than our product. If the carpenter shop doesn't plan its work so that it cuts forms out of a size board on which there is the least waste, or if the pipe shop doesn't cut pipe out of a pipe length that will produce the most prime pipe and the least waste, its yield will be out of line. The accounting, timekeeping, stores, personal

E&M Quality PUSH BUTTONS



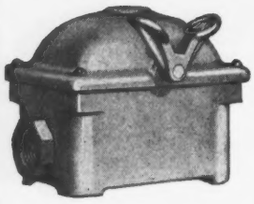
Splash-proof Push Button Control Station for machine tool application.

FOR automatic motor starters, controllers, lighting circuits, etc. Available in standard, vapor-proof, dust-tight and water-tight and Class 1, Group D enclosures. Bulletin 1105-A gives complete description. Write for your copy today.

THE
ELECTRIC CONTROLLER & MFG. CO.
CLEVELAND, OHIO

STANDARD TYPE J PUSH BUTTON

Type EO Push Button (Oil-Immersed or Air-Break) for Class 1, Group D service. Provision for padlock to lock in "off" position is furnished as standard.



VAPOR-PROOF PUSH BUTTON

THE ELECTRIC CONTROLLER & MFG. CO. E&M CLEVELAND, OHIO

HEAVY DUTY MOTOR CONTROL FOR CRANES, MILL DRIVES AND MACHINERY • BRAKES • LIMIT STOPS • LIFTING MAGNETS AND AUTOMATIC WELD TIMERS.

ACME TOOLS

A few of the 429 Acme tools and accessories which enable more than 20,000 users of Acme Steelstrap to effect maximum economies

—FOR MAXIMUM *Steelstrapping* ECONOMY AND SPEED

The tools and equipment used in *manufacturing* your products are selected because they do the job most economically and efficiently. Steelstrapping, too, can provide maximum savings, afford the greatest protection, and require the least amount of time and effort *when the right tool is used for each individual job.*

The Acme *Process* includes a complete line of tools and accessories. There is an Acme tool for every packing purpose, whether in the reinforcement of parcel post packages or carload shipments. Some tools tension the strap, others seal the joint, while still others combine these functions in one piece of equipment. In addition, there are accessories, tailor-made for the specific production and handling requirements of individual shippers.

The Acme analyst will be glad to demonstrate the Acme tool which will provide maximum advantage for you. Ask to have him call, or mail the coupon for the new 22-page booklet describing the advantages of the Acme *Steelstrap* Process, the Acme *Unit-Load* Process and the Acme *Skid-Load* Process.

MAIL THE COUPON FOR YOUR FREE COPY OF *"Stopping Profit Leaks"*

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ACME *Steelstrap* PROCESS
2831 ARCHER AVE. · CHICAGO, ILL.

ACME STEEL COMPANY
2831 Archer Ave., Chicago, Ill.

☐ Have the nearest Acme analyst call.
☐ Mail a copy of the new 22-page illustrated booklet, "Stopping Profit Leaks Beyond the Production Line."

Name.....

Address.....

City.....*State*.....

service departments, and all clerical forces have their yield to watch on supplies of all kinds. If these supplies are wasted the yield will not be up to par, and the sum of these waste items can throw the balance sheet off.

"*If you leave the door open* on your refrigerator at home, the refrigerator gets warm, doesn't it? The same thing happens when a drinking water valve is left open—it warms up the water in the whole system and does not make the water any colder at that particular fountain. Everyone can have cool, healthful water by seeing that the valve is closed after getting a drink.

"*The maintenance shops* turned in the highest labor efficiency of the year last week and this year is running well ahead of last year. This requires planning and every man doing his share. Fine work men—show the way.

"*Did you ever look at an order this way?* The Sales Department may bring in the orders, but when all is said and done, the problem of filling those orders is in the hands of the men in the mill. Orders are never completed sales until every man has successfully turned out the work assigned to him. The better this work satisfies the customer, the easier the job of selling him the next time becomes, and that means that in the long run we shall have more orders to work on. Keeping them coming back is a continuous selling operation in which every man has a hand."

Swapping Ideas Betters Safety Programs

(Continued from page 39)

are distributed. Clarion has charged department heads with a greater degree of responsibility than most of the plants, and the management is so determined that safety precautions be observed that employees are dismissed for infractions of safety rules. In the report, Clarion showed its strict attitude by saying:

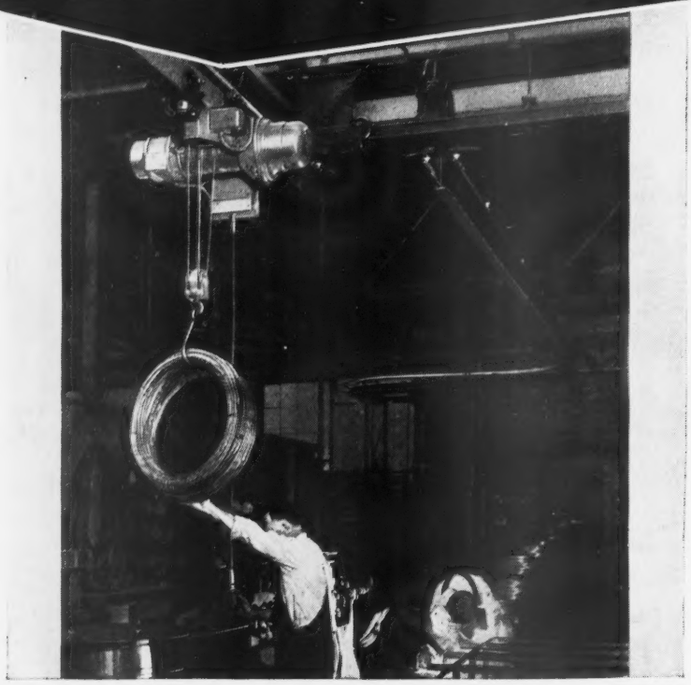
"Employees must know and understand that they will be laid off or discharged as quickly for violation of a safety rule as for poor workmanship. In fact, they should be laid off quicker, because they have wilfully disregarded orders. We feel it is better to send a man home alive and healthy than on a stretcher or in a hearse, and in doing this we feel we have done him a favor."

Once safety has been effectively promoted to department heads and supervisors, and they have been awakened to their responsibility for the observance of safe practices, promotion to employees becomes the next step. And it is a most important step. Employees grow careless, sacrificing the safe way for the short cut, unless safety is shouted to them every working day. The twelve plants get the safety idea across by bulletin boards and posters that shout safety ideas, departmental contests, meetings, slogan contests, the sale of protective equipment, rewards for safe operation, and novelties such as Alton's "Safety Derby."

The Alton safety campaign has probably been as complete and varied as that of any plant, and has as its focal point a display showing the progress of a continuous contest. First of these displays was the "Safety Derby," consisting of a small race track whose wooden horses progressed according to the safety records of the departments they represented. Horses were moved forward a little each day. If a lost-time accident occurred in any department, that department's horse remained stationary until the employee returned to work. On a doctor's case, without lost time, a horse was held back for a day. The derby was run on a four-month basis, each quarter post representing a month, but Alton recommends that other plants using this horse race idea place it on a monthly basis.

Each department finishing in a tie for first place received a pair of safety

P&H HEVI-LIFT HOISTS



GET SPEED AND LOWER COST WITH "THRU-THE-AIR" HANDLING

Off the floor! . . . out of the aisles! . . . "thru the air" handling give you swift, effortless movement of loads — saves money, saves man power, saves time. P&H hoist engineers will gladly recommend the most practical material handling methods for your individual needs. Why not investigate? Or ask us to send your copy of Bulletin H-5? The Harnischfeger Corporation, 4525 W. National Ave., Milwaukee, Wisconsin.

HARNISCHFEGER CORPORATION

HOISTS • WELDING ELECTRODES • MOTORS P&H EXCAVATORS • ELECTRIC CRANES • ARC WELDERS

REPLACE
INACCURATE EYES AND
FORGETFUL PENCILS WITH

F-M
Printomatic Weighers

● Your weight records can be perfect. The Fairbanks Printomatic Weigher does not have to be read by the eye or recorded by a scribble. There is no chance for even the smallest fraction to be missed . . . for the wrong weight to be set down through forgetfulness . . . or for hurried figures to be misread. Automatically the weight to a fraction is printed in easily read figures on a ticket, or on a tape locked away in a tamper-proof case.

The Printomatic Weigher is supplied as standard equipment on Fairbanks scales for a wide variety of services, or attached to your present Fairbanks scales. Get the whole story by writing Fairbanks, Morse & Co., Dept. 30, 600 South Michigan Ave., Chicago, Ill. Branches and service stations throughout the United States and Canada.

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WASHERS-IRONERS
FARM EQUIPMENT
STOKERS
AIR CONDITIONERS

FAIRBANKS SCALES

Scales

shoes, the shoes going to the employee lucky enough to have his name drawn from a drum containing names of all employees in the department.

Much joking about the type of feed different horses were getting, the horses' condition, and so on, created the talk and interest necessary for a good safety program. A record of lost-time and doctor's cases, posted on a small sign just behind the track, helped sustain this interest.

Next stunt in the "flash program" at Alton was a "safety chain," made of large links of pressed wood, each link representing a department. When an accident occurred, the link for the department where it occurred was released and allowed to hang down, showing a break in the chain. On a blackboard behind the chain, the accident causing the break was sketched and described.

After the chain came a "safety calendar," a large wooden sign board divided calendar-like into panels for each day of the month, each panel large enough to take an 8½x11-in. card describing an accident. In each panel was a socket for a 10-watt sign bulb, and at the close of each day a lamp was inserted to show the safety record for the day—a white light signified no lost-time accident, a blue a doctor's case. These blue bulbs showed up well even in daylight, and especially well at night when the board was lighted.

Besides the flash program Alton has a board mounted next to the display to carry the story of each accident. It carries slogans and safety messages when no accident has occurred. A large 22x30-in. poster is used in a conspicuous place and 8½x11-in. posters are mounted on departmental bulletin boards. The mimeographed sheets distributed to department heads and foremen at their weekly safety meetings have already been mentioned.

These meetings of the key men are not the only meetings at which safety is promoted, for full advantage is taken of the opportunity to spread safety propaganda at employee meetings at which safety statistics are presented through charts. These charts are made on 3x4-ft. canvas sign cloth and can be placed on a stand to use as illustrative lecture material. Department heads borrow them for their meetings and members of the organization use them as the basis for talks given outside the plant at luncheon clubs and schools.

Shows Nature of Injuries

The most interesting of these charts is the "Man Who Makes Our Bottles," a 30-inch-high outline of a man, on which parts of the body injured in accidents are indicated by black or red marks. Red indicates a lost-time accident and black a doctor's case. The complete story of a year's accidents goes on this figure, and provides illuminating information on which parts of the body are most vulnerable.

Departments having the best safety records get rewards. Department heads must contribute a quarter for each lost-time accident and a nickel for each doctor's case to a jackpot. The total pot goes to the welfare fund of the department having the best safety record for the entire year. "Little Safety Sam" carries along the same idea. Sam is a doll dressed as a factory worker, who goes into the possession of a department having an accident, and is nursed along by that department. Whoever has him must display him with a sign describing the accident, and a piece of adhesive tape marks the part of the body injured in the accident.

Several times yearly Alton manages to get some sort of safety news about the plant in the local newspaper. Not only does this react to the plant's favor among the townspeople, but it also lends importance to the safety campaign.

At Clarion they devised departmental safety contests designed to fit particular needs of the departments, and in the clockhouse an illuminated board, which tells all employees when

Safeguards ALL TYPES of bearings!
The correct oil film to each individual bearing... automatically
"Norton" Multipurpose Hydraulic Grinder
BIJUR
AUTOMATICALLY Correct LUBRICATION
● This machine is lubricated by a continuous film of clean oil metered to bearing surfaces of the table ways—in proportion to speed and extent of slide travel! Varying requirements of lubrication are met each instant . . . no mechanical adjusting necessary. Bijur equipment built into your machine will lubricate . . . correctly, unfailingly, automatically . . . any number of bearings of all types and sizes. Dismisses lubrication uncertainties!
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"NORTHERN HARD MAPLE is Most Suitable for Our Requirements"

says

STARTEX MILLS

Spartanburg, S. C.

The crash mill weave room in the Startex Mills, floored with genuine Northern Hard Maple.

"BECAUSE

of its even growth, compact grain, and long tough fibre, which is not the case of maple flooring, so far as we know, obtained from other sections."

"**Due to the heavy weight of the machinery,** together with the vibration from its operation," says Startex Mills, "it is necessary for the flooring material to have the proper strength and sufficient elasticity so that it will not crack or split."

"For these reasons, we have been using the *Northern* Hard Maple for a number of years."

Not all Maple is *Northern Hard Maple*—and only Northern Hard Maple offers the extreme tough fibre and tight grain that comes from slow growth in the hardy Northern climate, which is responsible for this flooring's remarkable service and economy.

When it's *Northern* Hard Maple, you insure lowest maintenance cost and highest resistance to abrasion—almost permanent smoothness, greatest ease of cleaning, and maximum employee comfort and efficiency.

It is easy to make sure. Merely specify **MFMA*** Maple, and look for this trademark, carrying the Association guarantee, on the flooring you buy.

MAPLE FLOORING MANUFACTURERS ASSOCIATION
1787 McCormick Building, Chicago, Illinois

• • •

See our catalog data in Sweet's, Sec. 11/77.
Write for photographic folder on Northern Hard Maple and leaflet on heavy-duty finishes for old or new floors.

**The MFMA trademark, indented and stamped on Maple flooring, guarantees it to be GENUINE Northern Hard Maple, graded and MFMA supervised in accordance with the Association's exacting standards.*

Floor *with* MFMA Maple

REG. U. S. PAT. OFF

(NORTHERN HARD)

an accident has occurred, ties all departments together. Milk bottle-shaped figures, one for each department, are lighted with a gold color until an accident occurs; then a red light is installed in the bottle representing the department that has had the accident. This light stays red until the end of the month. As a result of this program the two departments with the worst 1937 safety records went through 1938 with no accidents.

The Chicago Heights plant had a contest in which each department started the month with 100 points, lost points for accidents and failure to report for first aid. A scoreboard showed the standings at any time.

Clean-up and good housekeeping have been emphasized as accident preventives at this plant, and a good housekeeping contest and scoreboard are kept going. Graphs and charts are posted at conspicuous locations. Some of these charts are homemade affairs, many of them stenciled, but they all help put the safety idea across.

Other forms of departmental and plant safety scoreboards are used by the other plants, all incorporating the competitive theme. Oakland adds a novel touch by painting a large white cross wherever an accident has occurred. Columbus by means of pictorial posters reminds its employees what fun they'll miss by being injured. They show, for instance, a picture of a person lying in bed, and just opposite a picture of a baseball game, the two joined by a caption such as "Play and work safely and enjoy all our activities."

Slogan contests, painted wall signs, talks, articles and short items in employee magazines were some of the other safety promotion techniques used. At Oakland each department appoints one of its employees as safety committeeman, whose duty it is to look for hazards that may cause accidents, and report them to the safety inspector. Every three months a new committeeman is appointed so that there will be no danger of the committeeman losing his keenness for spotting danger.

A safety campaign that was literally sold to employees was Streator's sale of safety shoes. Three lost-time toe accidents resulted in putting on display a picture of one fellow's injured foot in its cast. Five pairs of safety shoes were bought by employees the next week. Then to promote this idea further, an exhibit of safety shoes and their construction, provided by a shoe manufacturer, was set up, and the purchase of these shoes encouraged.

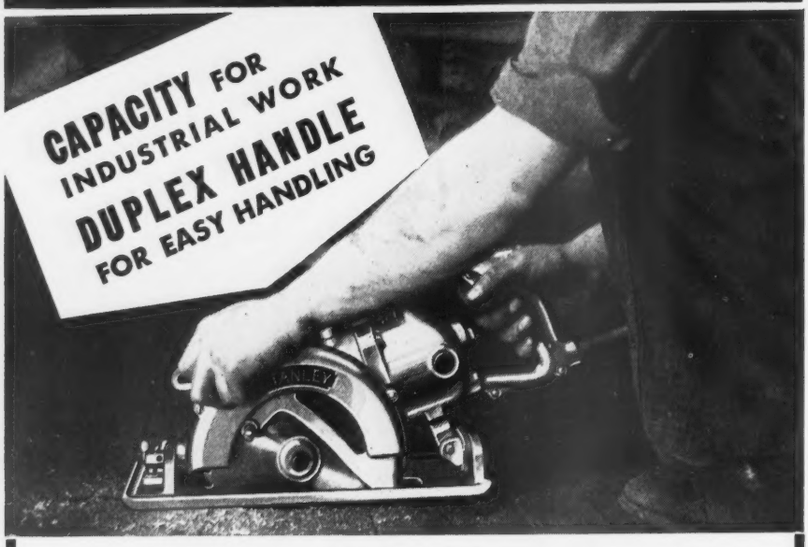
"Most Important of All"

The most important factor in the safety campaign's success remains to be mentioned—the plant manager. In its report Fairmont said that the entire cooperation of department heads and of the plant manager was "most important of all." "Our plant manager," they said, "is cooperating 100 per cent to promote safety . . ." Libbey reports: "The plant manager attends all safety meetings in order that the safety program may be cleared at once when expenditures for same are apparent. In case of negligence by any supervisor in carrying through the safety recommendations as made by the committee, he can know the facts without depending on second-hand information.

All of the Owens-Illinois plants are going to find ideas in this report. The variety of the promotion schemes used demonstrates the scope of a complete program. Even those plants reporting campaigns more comprehensive than the rest are going to glean from this report new ways of putting over the safety ideas they have already promoted. Clarion's milk bottle bulletin board idea may be exchanged for Alton's safety derby, for example. Plants that haven't done much as yet will find in the report enough material to keep safety drives alive for some time.

There is a possibility that displays will be exchanged among the plants, as

YOU CAN EXPECT MORE FROM A STANLEY ELECTRIC TOOL



..STANLEY W-8 ELECTRIC SAW

★ Capacity to 2¾" for Straight Cuts
★ Tilting Base for Bevel Cuts to 2-1/16" @ 45°
★ Handles Wide Range of Plant Work
★ Patented Duplex Handle Makes It Easy to Use
★ Simple Wing-Nut Adjustment for Depth of Cut

The right electric saw for year-round maintenance and construction jobs in industrial plants. Ask your dealer for a demonstration, or write today for literature. Stanley Electric Tool Div., The Stanley Works, 143 Elm Street, New Britain, Connecticut.

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A Complete Line for Industry — "Cost Less Per Year"

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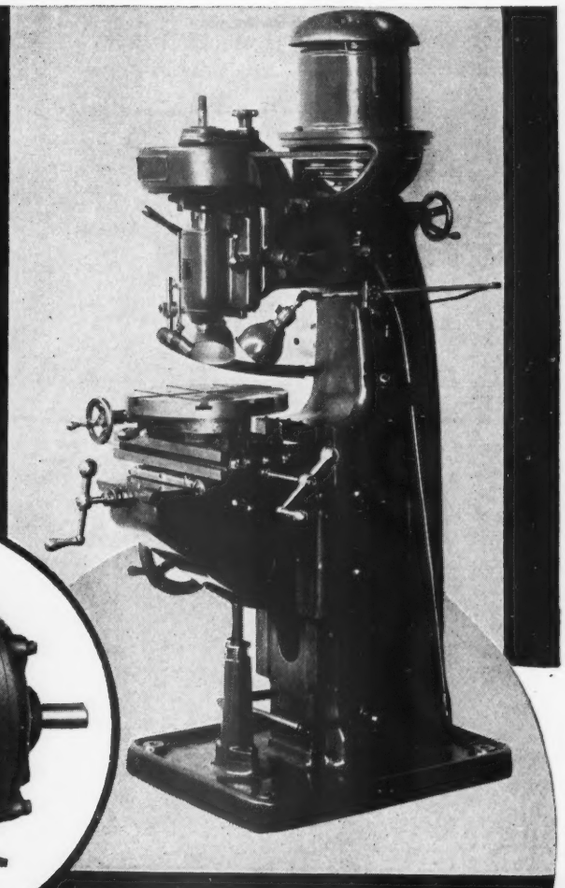

Century small size industrial motors give you, without extra cost, many added advantages of design and construction usually found only in large integral industrial power motors.

Electrically and mechanically, Century small size industrial motors are built to the same high standards and with the same performance features of Century's larger integral horsepower motors.

Century Motor Specialization + Correctly Engineered Application = Satisfaction and Economy

Only Century Gives You ALL These Features in Small Size Industrial Motors,—at no extra cost—to meet the greater abuse to which smaller size motors are subjected in industry

Bearings: Built with greater safety factor to abnormal belt tension stress—thick walls give sustained accuracy of roundness—shoulder provides large thrust surface, prevents lateral shifting of rotor.

These heavy duty, long life features result from sleeve bearings machined from phosphor bronze castings, diamond bored for accuracy of roundness.

Balance: Motor vibration frequently registers on the work surface —prevents close tolerances.

Century general purpose stock motors have gained an enviable reputation for being remarkably free from vibration.

End Play Shock Absorbers: End "bumping" of armature, caused by irregularity of V-belt or shive, is prevented by steel enclosed cork end play washers. Result—more accurate work—quieter operation.

Insulation: Laminated sheet insulation gives greater protection between winding and core. Varnished cambric for electrical insulation is highly resistant to moisture — fibre board gives mechanical strength.

Saturating the windings with Century special insulating compounds functions two ways — (1) seals surfaces and crevices between turns; prevents magnetic vibration of turns and breakdowns from chafing — (2) resists abrasives, moisture, oil, mild acids and mild alkalies.

These important features contribute substantially to long life.

Self Cleaning: Mechanical ventilation—air passages between the frame and field laminations provide a path for cooling air to carry away heat.

It pays to specify Century Motors on equipment you buy for your plant and to specify Century for your own power requirements. The highest quality is built into every Century Motor regardless of size —the difference in Century small size industrial motors is only in size and type, never in value or correctness of design. Thousands of plants depend upon Century industrial motors for dependable, economical, uninterrupted production.

Let your nearest Century motor specialist help you in selecting Century Motors to meet your particular requirements. Century has had 36 years of experience in the correct application of electric power. Call us in.

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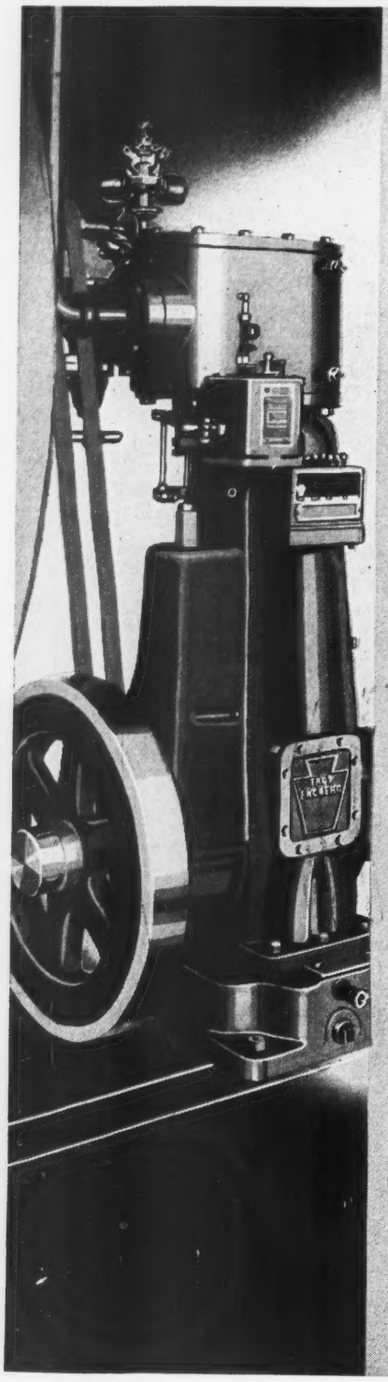


Lubricate cylinders without oil?

Unusual as that may sound, oilless lubrication of cylinders is accepted practice with Troy-Engberg steam engines. Where exhaust steam *free* from any oil contamination is desired, **TROY ENGINE & MACHINE CO.** uses "dag" colloidal graphite *in water* instead of oil . . . . . fed into cylinders through special lubricators.

The colloidal graphite forms a heat-resistant lubricating film of graphite on the pistons, rods, and other engine parts requiring lubrication. Graphite films developed on heating pipes also improve heat conductivity.

Where oil in exhaust steam is not a problem, the addition of "dag" to lubricating oil may be effectively used to reduce oil feeds and costs.

Bulletin 150, containing complete data on lubrication of steam engine cylinders with "dag", is yours for the asking.

ACHESON COLLOIDS CORPORATION

PORT HURON • • • MICHIGAN

dag COLLOIDAL PRODUCTS

this report brings to plant safety committees descriptions and pictures of what the rest of the plants are doing. Finally, company-wide safety promotion is assured.

Why and How We Train Apprentices

(Continued from page 46)

ing and once a month a lecture, throughout his training period. The lectures are given by our executives, and usually pertain to a review of opportunities for the trained man, tool scheduling, job simplification, plant layout, and a comprehensive study of the manufacture of our product.

No one textbook seemed to meet our requirements. Rather than seek subject matter from many sources, we compiled a textbook referred to as "Tool and Machine Technology," consisting of problems which, we believe, may confront our students and graduates. It is expected that our apprentices will use it for reference after graduation, just as they would use any other necessary working tool.

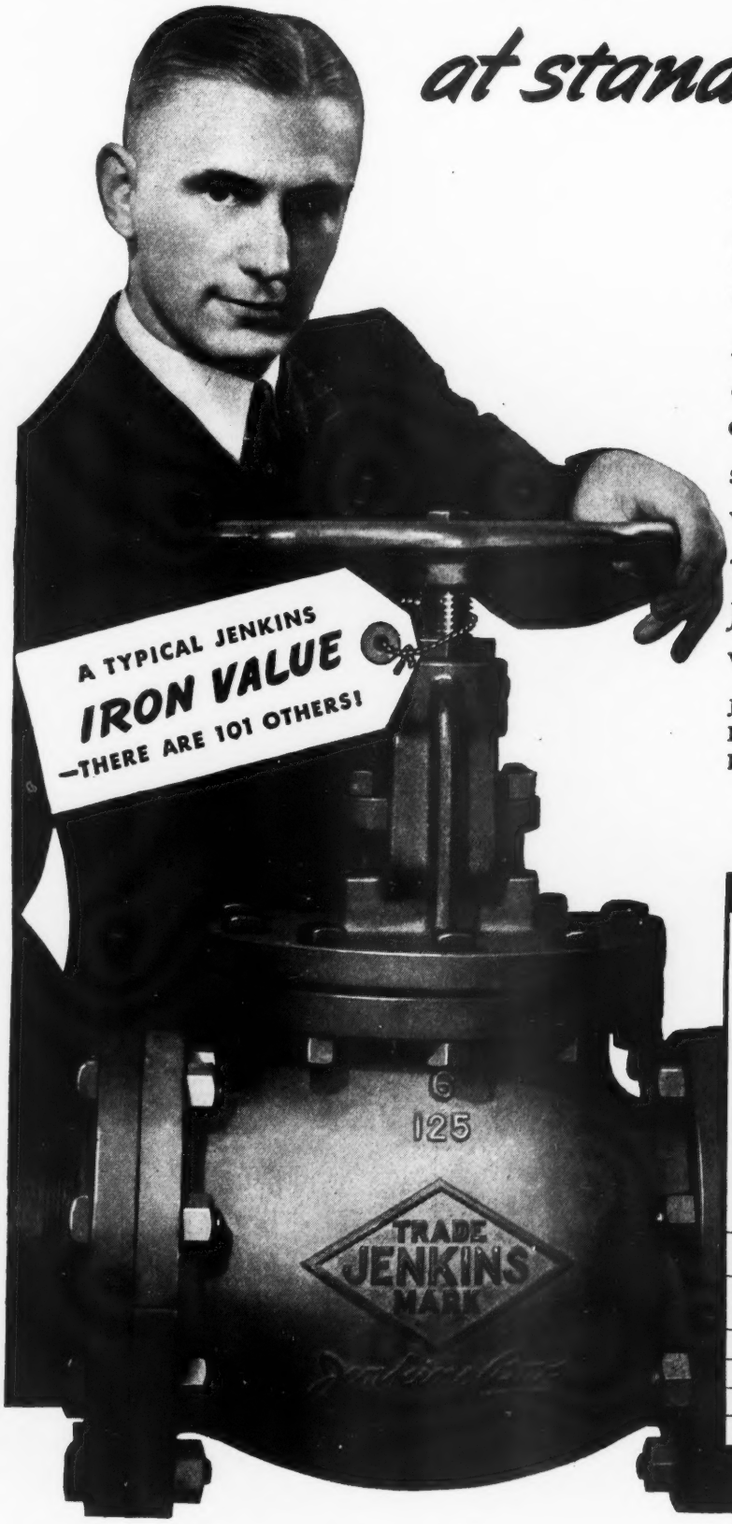
Through the General Motors Institute, we are able to get other books on shop theory, mathematics, economics, standards, and management. It is the Institute's function to serve as a central agency through which all subsidiaries may have access to textbook material for their training work.

During normal times approximately 50 students are enrolled in our training school. Provision is made for 17 first-year students, and one instructor in the shop. All the second- and third-year students in the toolroom, machine shop, and drafting room report to their respective foremen for work, but remain under the guidance of the apprentice supervisor.

So much for the actual intensive training. Realizing that "all work and no play makes Jack a dull boy," we plan a few extra play periods. These are usually in the form of an occasional day's outing for the entire group, with their instructors. At other times during the year educational trips are conducted through other industrial plants in the New York area, to give the boys a broader knowledge of manufacturing in general. The students are also represented in all other shop activities, such as glee club, soft ball league, and bowling.

The company awards a "Certificate of Apprenticeship" when the prescribed course of 7,200 hours has been successfully completed. Rather elaborate graduation exercises are held during Christmas week of each year. Previous

Top-Quality JENKINS iron VALVES *at standard prices!*



TO ALL Iron Valve buyers, we say — this Jenkins 125 lb. Regrinding Globe is as different as *profit* and *loss.*

And to prove it, we ask — go to your local distributor. Check over those new ease of operation and low maintenance features shown in the box. See for yourself the extra values you get in all Jenkins Iron Valves.

Then consider the cost — and you find Jenkins Iron Valves meet competitive "good valve" prices, penny for penny!

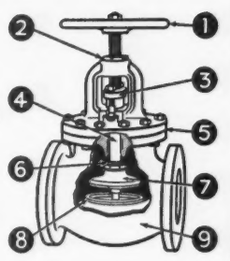
JENKINS BROS., 80 White Street, New York, N.Y.; Bridgeport, Conn.; Boston, Mass.; Atlanta, Ga.; Philadelphia, Pa.; Chicago, Ill.; Houston, Tex; Montreal, Can; London, Eng.

1864 1939

DIAMOND ANNIVERSARY

PLUS FEATURES OF THIS REGRINDING GLOBE

1 Handy Grip Wheel
2 Full Length Yoke Nut
3 Husky Packing Gland
4 Liberally Threaded Spindle
5 High Pressure Asbestos Gasket
6 Back-Seating Permits Easy Repacking
7 Bevel-Faced Bronze Disc
8 Renewable Bronze Seat Ring
9 IRON *Exceeds* A.S.T.M. Standards



Guide to Figure Numbers of Jenkins Regrinding Globe Valves

STEAM PRESSURE	GLOBE		ANGLE	
	Scw.	Flg.	Scw.	Flg.
125 lbs.	612	613	614	615
150 lbs.	912	913	914	915
175 lbs.	918	919	920	921
250 lbs.	922	923	924	925

HANDLED WITH A YALE ELECTRIC TRUCK

7,500,000 lbs.—3,750 tons . . . A lot of tonnage in any man's language. Yet that's what one operator using a Yale High Lift Electric Truck is able to handle in 3 months for the Atlanta Plant of the King Plow Company.

And the units to be handled are not standard in size or shape. They run the gamut from metal scrapes to the heaviest die cuts. A real handling job if there ever was one.

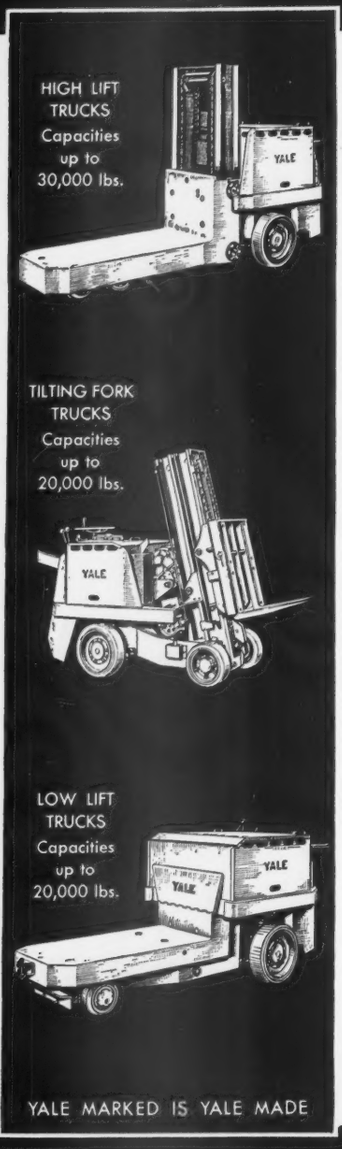
Here's what the King Plow Company has to say about their Yale Electric Truck:

"This truck does a 4-5 day job in 11 hours . . We find many jobs for this equipment which it was not originally installed to do . . . Almost before it was put to work it paid for itself . . . This truck never hesitates even for the longest and steepest ramps . . . It is indispensable—has saved substantially."

Indispensable—Never hesitates—Saved substantially . . . these words means saving and efficiency to the King Plow Company. And they can mean the same to you—for the Yale Electric Truck always conforms to the same service standard—the best.

It has to. Its drive units are more powerful . . . its construction is stronger—its engineering is more advanced. More than just a truck—the Yale Electric Truck is a mechanical efficiency expert! Send for free catalogue giving full information.

Trained sales engineers are located in 56 major industrial centers ready for instant service. Consult your classified directory.



YALE TRADE MARK

THE YALE & TOWNE MFG. CO.
PHILADELPHIA DIVISION, PHILADELPHIA, PA., U. S. A.
IN CANADA: ST. CATHARINES, ONT.

graduates are usually invited, making the affair a combination of graduation, Christmas party, and alumni reunion.

The student is paid $150 as a bonus if he fulfills his obligation in a satisfactory manner. After graduation, the foreman and the apprentice supervisor follow up on all graduates, so that as their ability develops they are promoted to machinists, and thereafter advance on their merit, similar to other employees. Some graduates, with increasing experience and maturity, combined with additional education acquired, advance to positions of greater responsibility in our company. Graduates are serving as estimator, assistant foreman, foreman, standards engineer, and as project and analytical engineers.

•

TRADE LITERATURE

Air Filter—Bulletin 250. Construction and operation of the "Electro-Matic" air filter combining electrical precipitation with automatic air filtration in dust removal.—American Air Filter Co., Inc., First and Central Ave., Louisville, Ky.

Bearings and Bushings—Catalog L-1. Facts about "Ledaloyl" self-lubricating bearings and bushings. Lead content, load-carrying capacity, contraction and expansion, installation. Progressive size listing.—Johnson Bronze Co., New Castle, Pa.

Belts—Catalog M 9332. "Belting Biographies" shows case histories of installations; contains technical information, selection data, speed of operation, pulley size, types of transmission drives and conveyor layouts, suggestions on improving belting methods.—Mechanical Goods Div., United States Rubber Co., 1790 Broadway, New York.

Breakers—Bulletin GEA-3143. Type FH breakers in metal cells and cubicles for power-station service up to 23,000 volts and 2,500,000 kva. Location, installation, construction, diagrams, illustrations.—General Electric Co., Schenectady, N. Y.

Car Spotters—Bulletin 106. Illustrations, diagrams, foundation plans, specifications on car and bar haulage systems and car retarders.—Robins Conveying Belt Co., 15 Park Row, New York.

Chains and Sprockets—Catalog M. Handbook on single- and multiple-strand roller chains and sprockets for power transmission, conveying, elevating; speeds, sprocket ratios, chain tension, adjustment idlers, lubrication, horsepower diagrams and tables for transmitting up to 600 horsepower. Requests for copies should be made on business letterhead.—Baldwin-Duckworth Chain Corp., Springfield, Mass.

Check Valves—Form 122-35. Design and construction, sizes and prices, uses, of check valves for Armstrong steam traps.—Armstrong Machine Works, Three Rivers, Mich.

Clamp-Ammeter—Circular A-2-B. Six-range clamp-ammeter for measurement of electrical conductors up to 2 in. in diameter.—Weston Electrical Instrument Corp., 614 Frelinghuysen Ave., Newark, N. J.

Cleaning—Brochure. The Oakite 30th Anniversary Brochure in a dramatic presentation of what the company's cleaning materials and methods—for maintenance and production operations—have contributed to all lines of industry.—Oakite Products, Inc., 22 Thames St., New York.

Control—Bulletin 680-1. Describes operation of "Rheotrol" manual control.—Wheelco Instruments Co., 1929-33 South Halsted St., Chicago.

Coolers—Bulletin S-500-B37. Evapora-

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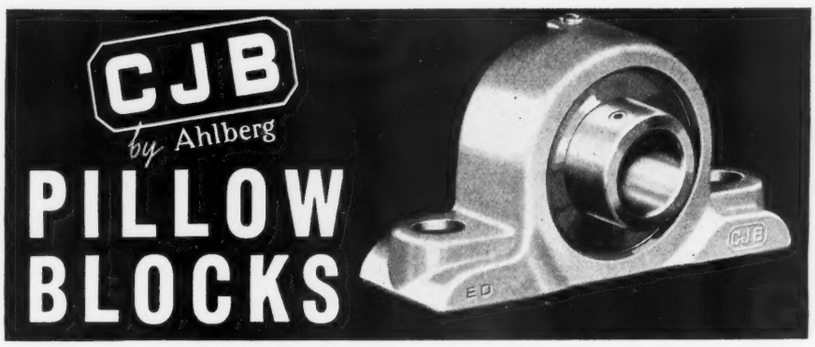
Here, at last, is a ball bearing pillow block which makes anti-friction efficiency economically practical for every type of light-duty application!

Substantially constructed—smooth in performance, yet exceptionally low in cost. The industry has been waiting for a "cost-design" pillow block like this . . . and Ahlberg engineering has met the need! Get the complete "dope" on this remarkably efficient bearing, immediately. Send for the Bulletin shown at the right.



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ALSO AVAILABLE IN SILENT, RUBBER-INSULATED TYPE
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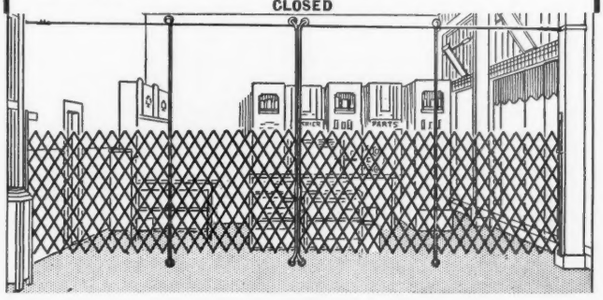

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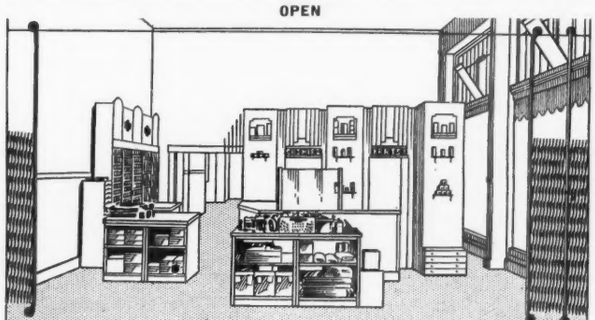

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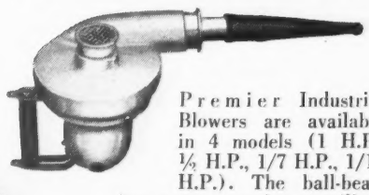

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Premier's Industrial Vacuum Cleaner, (Model 169,) is a most practical piece of equipment for practically every industrial cleaning job—ideal for walls, floors, stock bins, shelving. Efficiently picks up shavings, washers, nuts and scrap.

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Well-arranged washrooms equipped with ScotTissue Towels save money . . . build good will

How long since you have visited your plant washrooms? You may find, as others have, that more time is wasted here than in any other part of your plant or office. Inefficient arrangement, poor fixtures, a limited supply of towels—any or all of these things cause congestion and loitering, eat up overhead.

Actual work in planning and equipping thousands of plant and office washrooms to give efficient, more economical service has resulted in the Scott Washroom Advisory Service.

Why not send for our free booklet which explains how washrooms can be made to pay their way in terms of increased good will among workers, and reduced costs from time and material saved?

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tive coolers for engine jacket water for use with stationary-type diesel and gasoline engines. Dimension and piping arrangement diagrams, capacity ratings.—Worthington Pump & Machinery Corp., Harrison, N. J.

Couplings—Catalog 57. Engineering data, installation and operating information, applications for flexible, silent-chain, and roller-chain couplings, "Morflex" couplings and Morflex radial couplings and universal drive shafts.—Morse Chain Co., Ithaca, N. Y.

Drills—Supplement to 1939 Catalog. Seven electric drills—utility and heavy-duty models, and 2 drill stands. Specifications, prices.—The Van Dorn Electric Tool Co., Towson, Md.

Drills, Sanders, Grinders—Catalog 39. Electric drills, sanders, grinders for automotive, aeronautical, industrial work. Specifications, prices.—Jas. Clark, Jr., Electric Co., Inc., Louisville, Ky.

Electrodes—Bulletin. Stainless steel electrodes—chemical and weld deposit analyses, welding procedure for various stainless steels.—The McKay Co., York, Pa.

Flexible-Shaft Tools—Bulletin 394. For grinding, polishing, buffing, rubbing, wire brushing, sanding, filing and drilling operations.—Stow Mfg. Co., Inc., Binghamton, N. Y.

Fluorescent Lamps—Booklet LD-1 (Sup.). Engineering data—lamp operating data, lamp performance factors, auxiliaries, operating characteristics, color quality, and application of fluorescent Mazda lamps.—General Electric Co., Nela Park Engineering Dept., Cleveland.

Gages—Catalog. Laboratory test gage, "Duragages," chemical gage, ammonia gage.—Ashcroft American Gage Div., Manning, Maxwell & Moore, Inc., Bridgeport, Conn.

Gas Valve—Bulletin 1224-1. Describes operation of modulating gas valve.—Wheelco Instruments Co., 1929-33 South Halsted St., Chicago.

Generating Sets—Bulletin 108. Marine and stationary, vertical and horizontal, a. c. and d. c. generating sets. Descriptions, illustrations, data.—Troy Engine & Machine Co., Troy, Pa.

Ground-Ohmer—Bulletin 157. Modified "Ground-Ohmer" for measuring resistance of ground connections.—Herman H. Sticht & Co., 27 Park Place, New York.

Insulation Resistance Measurement—Bulletin 173. Model DM Megohmer which now features triple-color grading scale. Construction, application.—Herman H. Sticht & Co., 27 Park Place, New York.

Insulation Resistance Testers—Leaflet MB-203. Model MB-6 rated at 100,000 ohms to 10,000 megohms, in 2 ranges. Model MB-8 rated at 1 megohm to 100,000 megohms, in 2 ranges.—Industrial Instruments, Inc., Bayonne, N. J.

Intercommunicating Systems—Bulletin 205. Limited and unlimited switchboard systems, limited and unlimited selector systems, centrally controlled and party-line systems, 2-station system, accessories, cable, design.—Edwards & Co., Inc., Norwalk, Conn.

Iron Pipe—Form ADV 333. Toncan copper molybdenum iron pipe. Electric weld process of manufacture, rust and corrosion resistance, recommended applications, tests, physical properties, sizes and weights.—Republic Steel Corp., Advertising Div., Cleveland.

Ladder—Leaflet. Combination step and extension ladder—5 sizes.—2 Way Saf-T Ladder Co., Green Bay, Wis.

Lamp-Lowering Hangers—Catalog 39, Price List. Lamp-lowering hangers, shock absorbers, lamp suspension accessories, chain, chain and cable fittings, wire cable. Construction data and illustrations.—The Thompson Electric Co., 1101 Power Ave., Cleveland.

Lift Jacks, Platforms—Folder DM1. Construction, specifications.—All Steel Welded Truck Corp., Rockford, Ill.

Lift Trucks—Folders. SSLT: single-stroke lift truck—2,000-3,500 lb. capacity. HLT: lift truck—2,500-5,000 lb. Dimensions and specifications.—The Service Caster & Truck Co., Albion, Mich.

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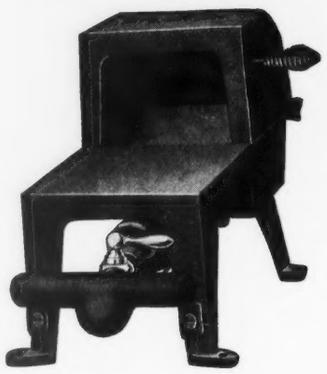
Johnson's No. 501 Furnace Gives Higher Heat at Less Cost



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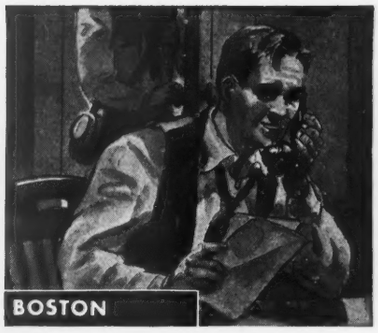
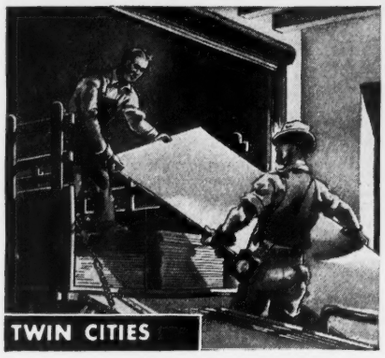
8 WAREHOUSES THAT *Rush* AS ONE!



"Urgent phone call received on holiday —goods shipped that same day."



"Plates had to be cut to size—ordered 4:35 P.M.—shipped that night."

"Carload of beams for R. R. bridge ordered 2 P.M.—shipped at 4 P.M."

"Emergency for flood work— shipped in 3½ hours."

"Order received at 4 P.M.— shipped at 6 P.M."

"Order received Sunday— shipped same day."

"Must receive tomorrow morning." (They did)

"Delivered in 6 Hours."

USS Scully Service

IT'S the same story with each of the eight Scully Warehouses. They all operate on the principle that our customers always want their material shipped at once. Regular orders, special orders, rush orders—they all get Scully Service. (Of course, when you say "rush" we know you want extra prompt attention—and we act accordingly.)

Phone, write or wire the Scully warehouse nearest you. Each carries large stocks ready for immediate shipment. And ask for our complete Stock List and Reference Book. It's free, of course.

When you re-tube boilers . . . remember Scully. Complete stocks to fit all requirements ready for instant shipment.

SCULLY STEEL PRODUCTS COMPANY

Distributors of Steel, Steel Products, Copper and Brass

Warehouses at

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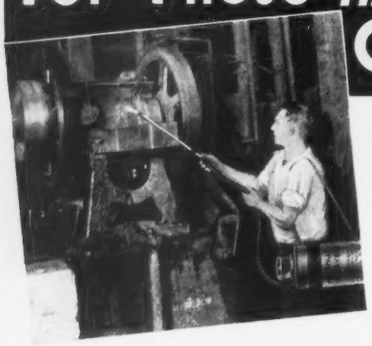
UNITED STATES STEEL

For Those HARD-TO-GET-AT Cleaning Jobs!



You have plenty of greasy, dirty machines, equipment and inaccessible locations in your plant for which efficiency and safety demand regular and adequate cleaning.

They may be hard to get at, but

MAGNUSOL

will do a quick, economical and thorough cleaning job on every one of them.

You simply spray it on—then flush it off with water. It penetrates and loosens all oil, grease and dirt deposits, then forms a completely soluble emulsion with the water that flushes off readily to leave a clean film-free surface.

No need to take chances with dangerous volatile solvents. Magnusol is non-flammable. No danger to workers' skin or hands—nor to paint, metal, rubber, etc. Magnusol is neutral and harmless.

Magnusol has many other uses, too—for cleaning greasy floors; for cold tank cleaning of metal parts; for cleaning painted surfaces; for cleaning motors and chassis of your trucks and autos.

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To correct certain false impressions regarding machinery vibration and to remove the apparent mystery surrounding this source of industrial loss, Korfund offers: **"ELEMENTS OF VIBRATION CONTROL."**

This bulletin, as the name implies, explains clearly and in simple terms what vibration is, its cause and effects, and how to select economical cures for its destructive force. It is not a sales bulletin nor a theoretical treatise but rather a plain, practical discussion of a major industrial problem. Your complimentary copy will be sent promptly upon request.

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loading, refining, finishing processes; lubrication of industrial equipment—requirements and technical practices. Illustrations.—Sun Oil Co., 1608 Walnut St., Philadelphia.

Motor Protection — Bulletin F-8490. "Thermoguard" automatic watchman for protection of small motors against burnouts—automatic-reset, manual-reset, and automatic time-delay types.—Westinghouse Electric & Mfg. Co., Dept. 7-N-20, East Pittsburgh.

Motors — Bulletin 150. Single-phase motors in three types: repulsion, induction; repulsion start, induction run; capacitor.—Sterling Electric Motors, Inc., 5401 Telegraph Road, Los Angeles.

Oil Burner Motors and Parts—Leaflet F-8487. Motors in standard speeds for 110- or 220-volt circuits of standard frequencies; motor parts for single-phase and polyphase motors.—Westinghouse Electric & Mfg. Co., Dept. 7-N-20, East Pittsburgh.

Oilers—Folder. Illustrations of applications of oilers.—Gits Bros. Mfg. Co., 1846-62 South Kolbourn Ave., Chicago.

Pumps—Folder W-111-B6C. Horizontal, simplex, direct-acting piston pumps. Specifications, dimensions, diagrams and illustrations.—Worthington Pump & Machinery Corp., Harrison, N. J.

Pyrometers, Thermometers—Folder 772. Pyrometers, potentiometer recording pyrometers, resistance thermometers described and illustrated.—The Foxboro Co., Foxboro, Mass.

Recorders, Controllers—Bulletin 536. New line of pH recording and controlling instruments—amplifer unit, electrodes and lead wire.—The Bristol Co., Waterbury, Conn.

Reset Timer—Bulletin 260. Synchronous motor-driven reset timing relay for applications requiring one or more contact operations in a timed sequence.—Eagle Signal Corp., Moline, Ill.

Roller Chain Drives—Pamphlet F-104-E. Progress of roller chain drives from a single to 16 strands. Applications illustrated.—Diamond Chain & Mfg. Co., Indianapolis, Ind.

Rolling Doors, Grilles—Leaflet. Rolling and sliding grilles; float-over overhead doors; rolling, canopy, bifold, vertical-lift, and accordion doors.—Cornell Iron Works, Inc., 36th Ave. & 13th St., Long Island City, N. Y.

Rotor—Bulletin 1152. One-piece, centrifugally cast copperspun rotor.—Fairbanks, Morse & Co., 600 South Michigan Ave., Chicago.

Steel—Catalog 59. Presentation of Amsco manganese steel, what it is, how it is produced. Illustrations of applications to various equipment. Alloys and welding rods.—American Manganese Steel Division of the American Brake Shoe & Foundry Co., Chicago Heights, Ill.

Steels — 1939 Stocklist. Specifications on beams, channels, angles, plates, hot-rolled bars and strips, high tensile steel, cold-finished bars, alloy and tool steels, sheets, cold-rolled strip, flat wire, stainless steels, tubes, welding rod, bearings, cutting.—Joseph T. Ryerson & Son, Inc., 16th & Rockwell Sts., Chicago.

Strapping Tool—Folder. "Ace" strapping tool with automatic seal feed.—The Stanley Works, Steel Strapping Div., New Britain, Conn.

Thermal Converter—Bulletin 533. How "Thermoverter" is used with potentiometers and millivoltmeters for a. c. electrical power measurement and totalization.—The Bristol Co., Waterbury, Conn.

Tires — Catalog 9-8352GP. Operator's handbook contains general and specific information, specifications and illustrations, on tires and tubes.—The B. F. Goodrich Co., Akron.

Vacuum—Folder. All-purpose vacuum machines. Models 55 and 16. General specifications, extra attachments.—Hild Floor Machine Co., 1313 West Randolph St., Chicago.

Vacuum Cleaners—Pamphlets. Model 169 vacuum cleaners for factories, warehouses, stores, offices. Heavy-duty blowers.—Electric Vacuum Cleaner Co., Inc., 1734 Ivanhoe Road, Cleveland.

Valve—Bulletin 2218. Automatic desludging valve for hot lime soda softeners. Specifications.—The Permutit Co., 330 West 42nd St., New York.

Variable-Speed Controls—Catalog. JFS-

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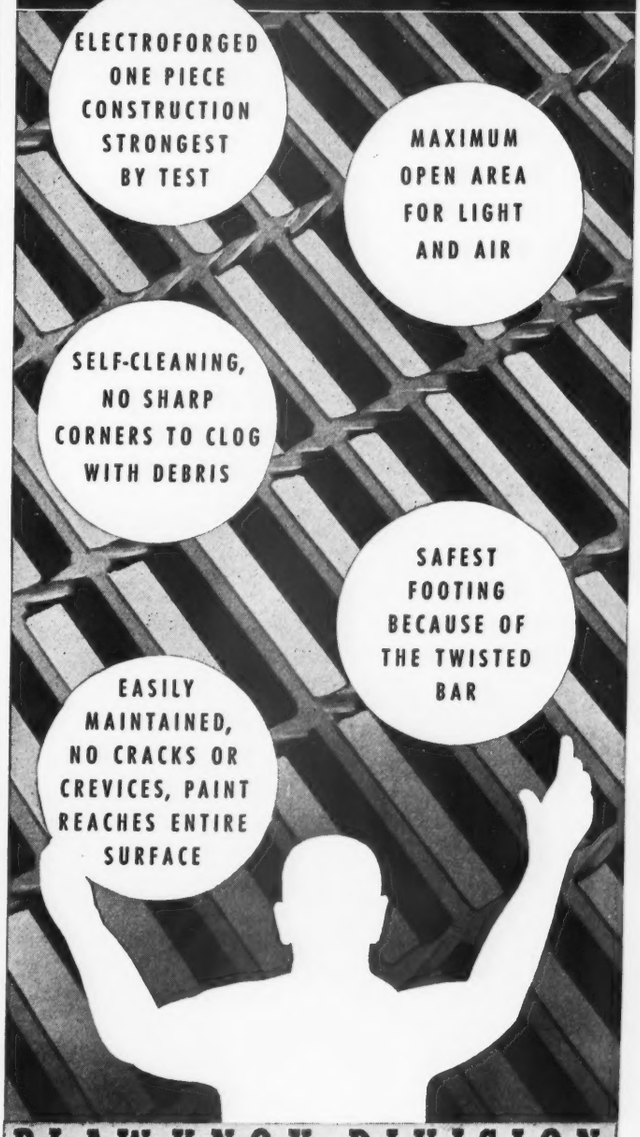
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Jr. variable-speed controls. Diagrams, selection tables.—Columbia Vari-Speed Co., Wheaton, Ill.

Washfountains—Folder P233. Improvements on treadle-controlled, group washfountains; group showers with or without treadle control.—Bradley Washfountain Co., North 22nd and West Michigan Sts., Milwaukee.

Water Filters—Bulletin 2225. Type F pressure filter featuring deflector plate distributor. Group control of filter units, expansible strainer heads, accessories. Illustrations, specifications.—The Permutit Co., 330 West 42d St., New York.

Waterproofing—Folder. Improved transparent waterproof coating No. V with calcium stearate base.—Ranetite Mfg. Co., Inc., 1917 South Broadway, St. Louis.

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BOOKS

A STUDY OF THE PHYSICAL ASSETS OF THE UNITED STATES—1922–1933

Rev. Edward A. Keller, Director, Bureau of Economic Research, University of Notre Dame. Bureau of Economic Research, University of Notre Dame, Notre Dame, Ind. 141 pages, tables. $1 cloth bound; $.50 paper bound; postage additional.

Object of this book, presenting the first results of a research program on the national economy, is to point out the truth about our material existence with the aid of official government data. Subjects considered include the fundamental concept of wealth; production equipment; science and invention; value of physical assets where used for production and for comfort; value of farm physical assets, commercial and industrial fixed assets, railways and other public utilities, stocks of goods, gold and silver, urban residential realty, tax-exempt property, chattels; value of the United States Navy.

MEDICOLEGAL PHASES OF OCCUPATIONAL DISEASES

C. O. Sappington, Consultant, occupational diseases and industrial hygiene. Industrial Health Book Co., 540 North Michigan Ave., Chicago. 405 pages, index, tables, illustrations. $2.75.

Presentation, in handbook form, of the industrial, insurance, medical, and legal inter-relations of the elements of occupational diseases from origins and causes to disabilities and costs. Written in nontechnical language, it is for those who may or may not have had medical, legal, or engineering training.

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ON THE CALENDAR

AUGUST

30–September 2. Silver Bay Conference on Industrial Relations, Silver Bay, N. Y. E. H. T. Foster, Executive Secretary, 347 Madison Ave., New York.

SEPTEMBER

7. Rutgers University Fourteenth Annual Industrial Conference, New Brunswick, N. J. Professor J. H. Vertrees, University Extension Division, Rutgers University, New Brunswick, N. J.

20–22. National Industrial Advertisers Association, Inc., Annual Conference, New York. Miss Mildred R. Webster, Headquarters Secretary, 100 East Ohio St., Chicago.

OCTOBER

4–13. National Machine Tool Builders Association, 1939 Show, Cleveland. Mrs. Frida F. Selbert, Secretary, 10525 Carnegie Ave., Cleveland.

22–27. American Welding Society, Annual Meeting, Chicago. M. M. Kelly, Secretary, 33 West 39th St., New York.

23. National Electrical Manufacturers Association, Annual Meeting, Chicago. R. J. Blais, Convention Manager, 155 East 44th St., New York.

INSULUX LIGHT-CONDITIONING

Gives Monsanto a Laboratory as Modern as its Products

MONSANTO Chemical Company must have modern laboratories efficiently planned for their work — research in chemicals and plastics.

That's why Monsanto's new Dayton Laboratory is *light-conditioned* with Insulux Glass Block. Wall panels of Insulux bring in all the light needed — evenly diffused light that lessens eyestrain and promotes accuracy.

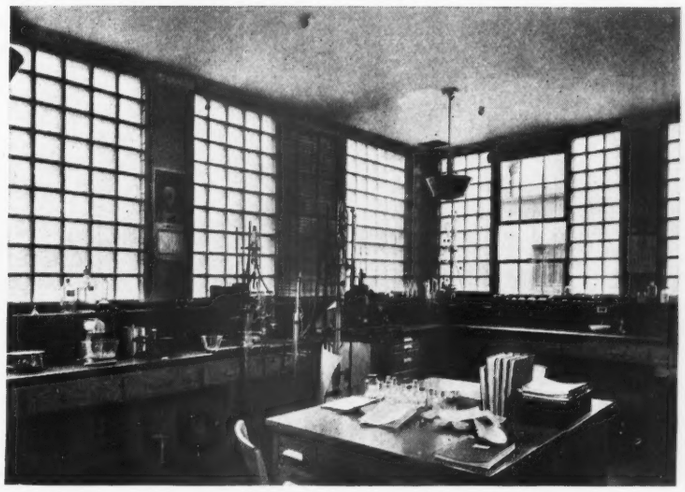
But better lighting is only one of many advantages Insulux Glass Block offer industrial builders. These hollow block, partially evacuated, have high insulating value — an aid in air-conditioning and heating, too. Panels of Insulux are barriers against dust and noise.

Insulux Glass Block are easy to clean and require no painting. An additional factor in reducing maintenance costs is the high resistance of Insulux to the corrosive action of most chemicals and gases.

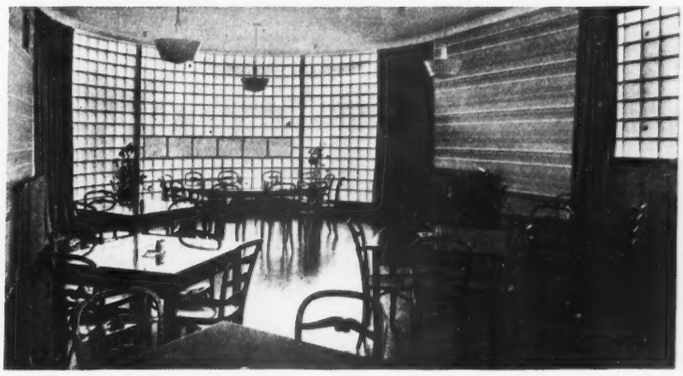
Your architect can show you how you can use Insulux light-conditioning when you build or remodel, or write Owens-Illinois for our new book on Insulux in Industry.

OWENS - ILLINOIS
INSULUX Glass Block

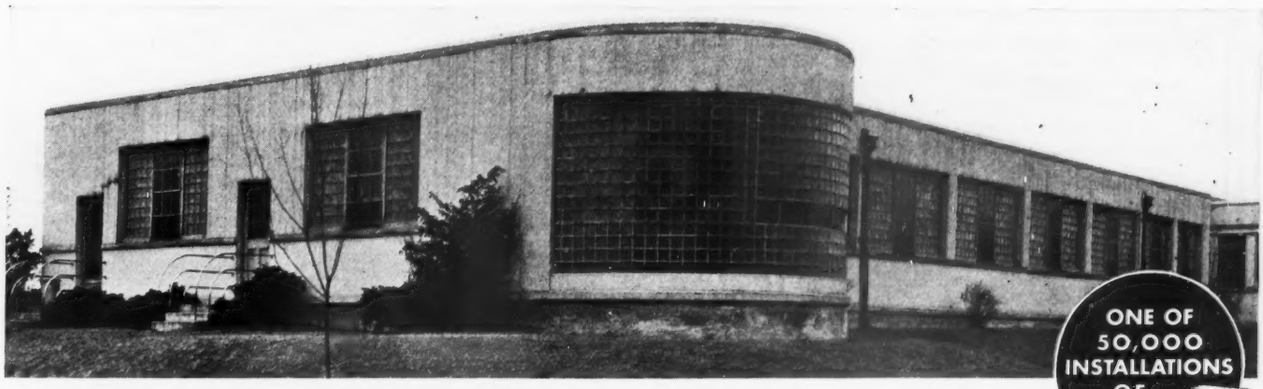
OWENS-ILLINOIS GLASS COMPANY
Insulux Products Division, Toledo



Insulux panels pour diffused light into this modern laboratory, yet assure privacy for workers.

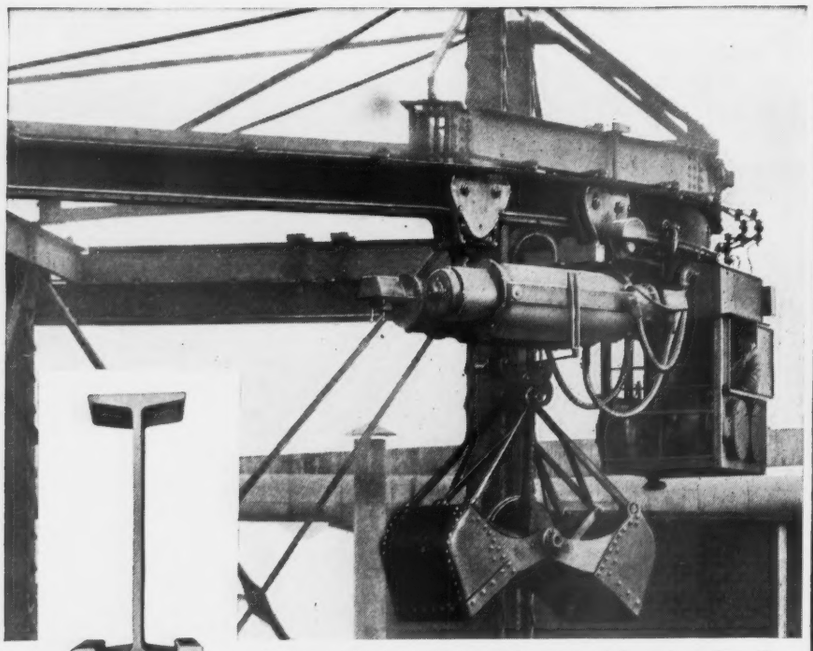


In the laboratory luncheon room, cheerfully light but private, the curved Insulux wall panel is a decorative architectural feature.



The high insulating value of Insulux Glass Block makes practical and economical the use of large light-transmitting areas in industrial buildings.

ONE OF 50,000 INSTALLATIONS OF INSULUX



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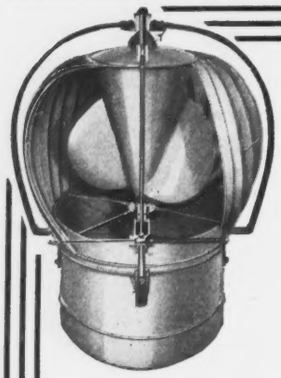

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2 **Roof Ventilators** — Complete data sheets and catalogs available on Roof Ventilators of all types, including Stationary, Revolving, Continuous Ridge and Electric Fan Units. Also, similar material for Gravity Oil Filters and Steam Exhaust Heads. **Burt Manufacturing Co.**

3 **Unit Heaters**—Attractive catalog explaining the advantage of unit heating for comfort and economy, for new buildings or for modernizing the heating of present industrial buildings. Capacity ratings are listed for 28 sizes; also construction details, dimensions and typical diagrams. **Grinnell Co., Inc.**

4 **Ventilators and Skylights**—Manual No. 42. Gives complete illustrations and specification data. All ventilator dimensions are listed and accurate exhaust displacements and shipping weights given. Full-size cross section details depict construction of each of the skylights, including the new No. 850 series. **Milcor Steel Company.**

5 **Dust Collectors**—A 24-page bulletin (No. 197) on All Metal, Cloth Screen, Dust Collector. Describes the exclusive features available for modern economical dust control. Many large photographs, charts and drawings clearly illustrate the 14 outstanding points of superiority claimed for this dust collector. **Pangborn Corp.**

6 **Dust and Fume Removal**—Catalog No. 337-1 contains information regarding Sturtevant Exhaust Fans for removing dust from grinding, polishing, and buffing wheels, tumbling barrels, sand blasts, etc.; for conveying waste and raw materials such as cotton, waste-ends, sawdust, fine cork, etc.; for exhausting smoke, fumes, and vapors from small rooms, forges, chemical laboratories, soldering pots, spraying booths, etc. **B. F. Sturtevant Company.**

Building, Construction, and Maintenance Materials

7 **Collapsible Partitions**—New literature describes new type of folding partitions with overhead cables. The material used is ¾ in. channel. The collapsible partitions are intended for use when spaces need to be partitioned off daily or more frequently. These collapsible partitions may also be used in door openings during the day or window openings during the night for burglar protection. **The Chicago Wire Iron & Brass Works.**

8 **Sanitary Equipment** — A 32-page illustrated booklet titled, "Crane Plumbing for Industrial and Commercial Buildings". Provides authoritative data on how to handle industrial sanitation problems. Points out what equipment to use, where and why—makes correct selection of equipment easier. **Crane Co.**

9 **Care of Industrial Floors**—New literature describes and illustrates the various floor machines and mop trucks (43 different models), as well as waxes, powders, soaps, sealers and accessories. Provides a time and labor savings answer to every problem of floor preservation, sanitation and maintenance. **Finnell System, Inc.**

10 **Portable Vacuum Cleaners**—A new booklet about proper "housekeeping" procedure. It gives the formula for greater plant cleanliness at lower cost. Case histories are included. The three Invincible portable vacuum cleaners most widely used by industry are described. **Invincible Vacuum Cleaner Mfg. Co.**

11 **Steel Doors**—36-page catalog fully illustrates a complete line of steel rolling, sectional upward acting, and other space-saving efficient doors. This very useful book contains details of construction and application. **Kinnear Manufacturing Company.**

12 **Glass Block**—Industrial Book IB-13. A 36-page catalog giving complete information on the place of glass block in industrial design; description of designs and sizes; construction details; basic specifications; and test data. **The Owens-Illinois Glass Company.**

13 **Fence Facts**—A new booklet illustrating and describing chain link fence in a variety of styles and four different metals for every type of fencing installation. Also wrought iron fence in various beautiful styles. A concise handling of information for those wanting facts about fence. **Page Fence Association.**

14 **Roofing**—Interesting, illustrated bulletin describes Ru-ber-oid Roll Roofing with patented Eason Flaps. Graphically pictures advantages of 7-layer built-up seam with sealed laps and all nails covered. Bulletin describes the ease and economy of installation over old roofs or for new. **The Ruberoid Co.**

Compressors, Piping

15 **Air Compressors**—Bulletin HAC-36 gives full details about the special features of design and construction which enable users of Gardner-Denver Two-Stage Horizontal Compressors to achieve greater air output at reduced operating and maintenance cost. Capacity controls which exactly fit air supply to air needs are also explained. **Gardner-Denver Co.**

16 **Pipe For Industrial Uses**—Bulletin 337—a 42-page catalog filled with useful facts about Spiral Welded Pipe, supplemented by large, easy-to-read charts and tables. Explains how to determine pipe size and wall thickness; estimate pumping costs; eliminate unnecessary flanges, etc. Includes data on protective coatings, various types of joints, recommended methods of installation. **American Rolling Mill Co.**

Electrical Equipment, Welding

17 **Neotron Weld Timer**—4-page booklet on new low cost precision Weld Timer for resistance welding machines. Timer operates on electronic principle and provides accurate timing for each weld. Also, a folder (No. 930) describing EC&M Frequency Relay Magnetic Control. **The Electric Controller & Mfg. Co.**

18 **Copperspun Rotor** — Bulletin No. 1152 describes in detail new Copperspun Rotor—a truly one-piece indestructible rotor winding, having high electrical conductivity, low thermal expansion, and high mechanical strength, even under abnormal temperatures. **Fairbanks, Morse & Co.**

19 **Welding Control**—20-page Bulletin WLD 5. A study of resistance welding, machines required and control equipment. Describes the various types of resistance welders used in industry and the problems encountered in the application of all kinds of control to them. **Square D Company.**

Industrial Rubber Products

20 **Money-Saving Rubberlike Material** —Concise, easy-to-read booklet describing the many money-saving industrial uses of neoprene, duPont's chloroprene rubber, as well as neoprene products made by leading rubber manufac-

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21 **Mechanical Rubber Goods**—Catalog includes illustrations and descriptions of all major lines of industrial Mechanical Rubber Goods—belting, hose, packing, molded goods, etc. **The Goodyear Tire & Rubber Company, Inc.**

22 **Complete Data on Conveyor Belting**—For full information consult pages, 3, 4, & 8 of Thermoid's catalog on Industrial Rubber Products. A complete line of belting, hose, packings, and brake linings are also described in the same catalog. **Thermoid Rubber Division of Thermoid Company.**

Materials Handling

23 **Lo-Hed Hoists** — Complete catalog describing hoists of many different sizes and capacities, as well as supplementary bulletins giving technical data and specifications sheets for each type of hoist. All material has been prepared so that plant men can easily specify the hoist best suited to their needs. **American Engineering Company.**

24 **Materials Handling**—Three booklets, L-253, L-257, L-261, and catalog L-222R describing in detail hand trucks, platform trucks and barrel handling trucks and accessories designed to facilitate storing, shifting and loading of raw materials and finished goods. Well illustrated. **The Colson Corp.**

25 **Industrial Truck Batteries**—Folder describing briefly new type Exide-Ironclad Battery for modern industrial trucks 20,000 to 30,000 pounds capacity. Of particular interest to men in plants where large size, high load capacity electric trucks are used. **The Electric Storage Battery Company.**

26 **Trav-Lift Cranes**—28-page bulletin (H-13) describes different types of P&H "Trav-Lift" Cranes and how to speed up production and increase efficiency. Includes diagrams and specifications charts, clearances, and numerous photographs demonstrating typical installations to facilitate the selection of the right crane for every job. **Harnischfeger Corp.**

27 **Conveyor Textbook**—Over 100 illustrations of actual conveyor installations, putting "flow" into production under conditions similar to your own. Find here that handling idea you have been looking for. Semi-technical data in the production man's language. Shows where, how, and why different types of conveyors are used for maximum results. Catalog 35. **Logan Co.**

28 **Hoisting Equipment**—40-page illustrated catalog describing a complete line of hoisting equipment. Provides information on spur-geared hoists, winches, screw-geared hoists, trolleys, electric hoists and hand traveling cranes. Also contains valuable technical data on applications and capacities as well as replacement parts. **The Yale and Towne Mfg. Co.**

Miscellaneous

29 **Heat Fag**—Folder presents an interesting, descriptive analysis of the problem of "heat fag". An article entitled "Keeping in Condition by Using Salt", prepared by Dr. P. H. Kennedy, in question and answer form, is reprinted in full. Causes and effects of heat sickness, cramps and fatigue are discussed. Clearly explains the relationship of salt to workers' health. **Morton Salt Co.**

30 **Counting and Computing Devices**—General Catalog G-39 describes in detail a complete line of counting and computing devices . . . mechanically, electrically, and manually operated . . . for closer control of production, and greater utility and salability of a wide range of products into which they can be built. 40 photos of actual applications. Also Textile Catalog T-37, featuring the complete 2-3 Loom Pick Counter installation. **Veeder-Root, Inc.**

Packaging, Shipping

31 **Packaging and Shipping**—Well illustrated 24-page booklet describes new carload bracing practices used for shipping all types of industrial products. Shows how savings can be effected, damage claims and heavy bracing materials eliminated with the Acme Unit-Load Process of steel band application. Another "must" for plant and traffic executives is new 22-page booklet on "Stopping Profit Leaks Beyond the Production Line." **Acme Steel Company.**

Paint, Painting Devices

32 **Mill White Paint**—Booklet describing the money saving possibilities of duPont DELUX Mill White. Profusely illustrated showing actual case studies where this type of paint is delivering economical and satisfactory service. **Finishes Division, E. I. duPont de Nemours & Co., Inc.**

33 **Spray Painting Equipment**—A complete catalog of Finishing Room and Maintenance Painting Spray Equipment including Spray Guns, Material Containers, Spray Booths and Exhaust Fans, Air and Fluid Regulators, Hose and Connections, Air Compressors, Respirators, Paint Stripers, Automatic Coating and Finishing Machines. **The DeVilbiss Co.**

Plastics

34 **Instruction for Machining Bakelite Laminated**—An illustrated chart, suitable for hanging on wall, showing how to machine Synthane Bakelite-laminated sheets, rods and tubes. Also discussion of conditions under which parts are best bought already machined. **Synthane Corporation.**

Power Transmission, Lubrication

35 **CJB—Bearings and Pillow Blocks** is the title of a new condensed catalog giving detailed specifications and prices of a complete line of ball bearings and pillow blocks. Illustrations and detailed drawings make this catalog easy to use. **Ahlberg Bearing Co.**

36 **Lubrication**—Five booklets, "Alemite Portable Service Station" describes and illustrates power lubrication in the field. "Triple Savings for Industry" describes various Alemite systems used in barrel to bearing lubrication service. "A Modern Way to Lubricate Mine Cars" directed to the mine car field. "Your Guide to the Correct Lubricant" gives schedule for industrial uses. "Amazing New System of Lubrication for Tractors" describes hand power equipment for lubricating tractors in the field. **Alemite Div., Stewart-Warner Corp.**

37 **V-Belt Drives**—New catalog on Fractional Horsepower V-Belt Drives for all types of small machinery. The 40 pages of drive tables and other engineering information are so complete as to Horsepowers, Center Distances and Speed Ratios that a Fractional Horsepower V-Belt Drive for any service may be quickly selected without calculation. **The Dayton Rubber Mfg. Co.**

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Shop Equipment, Tools

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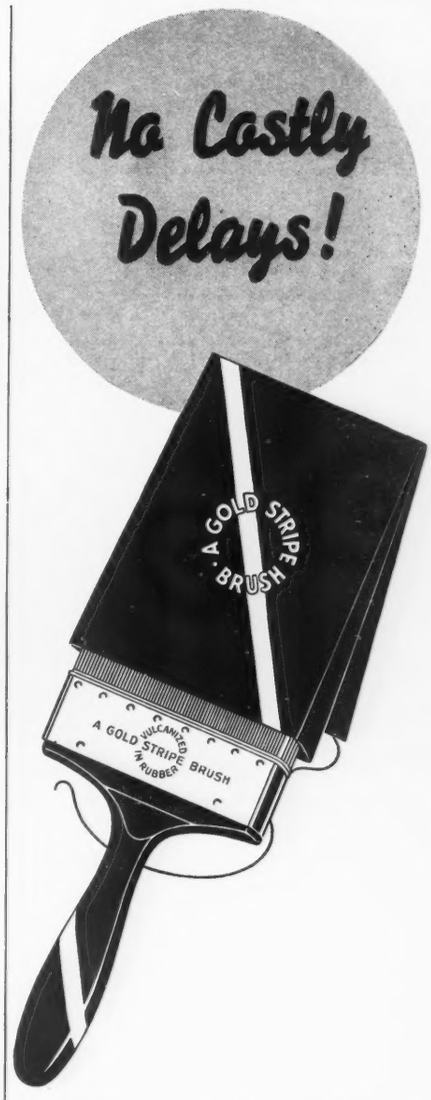

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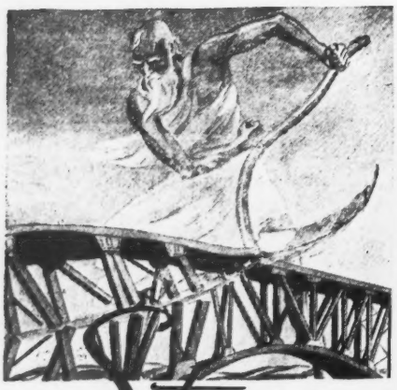

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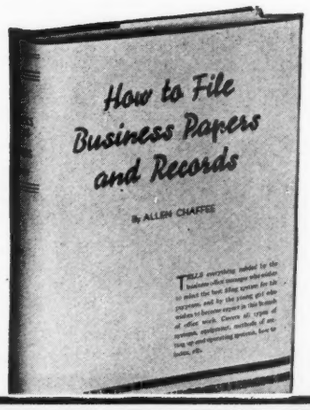

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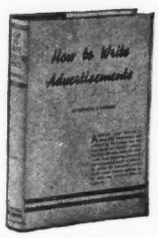

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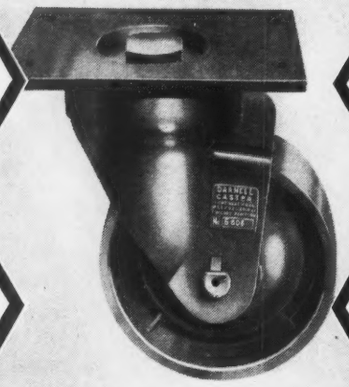

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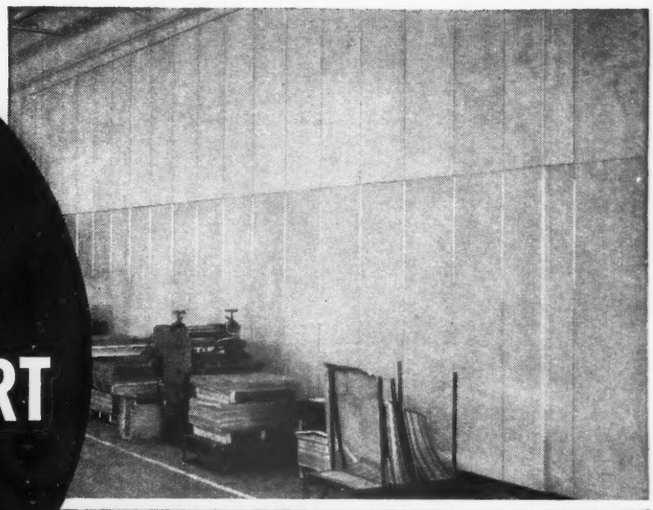

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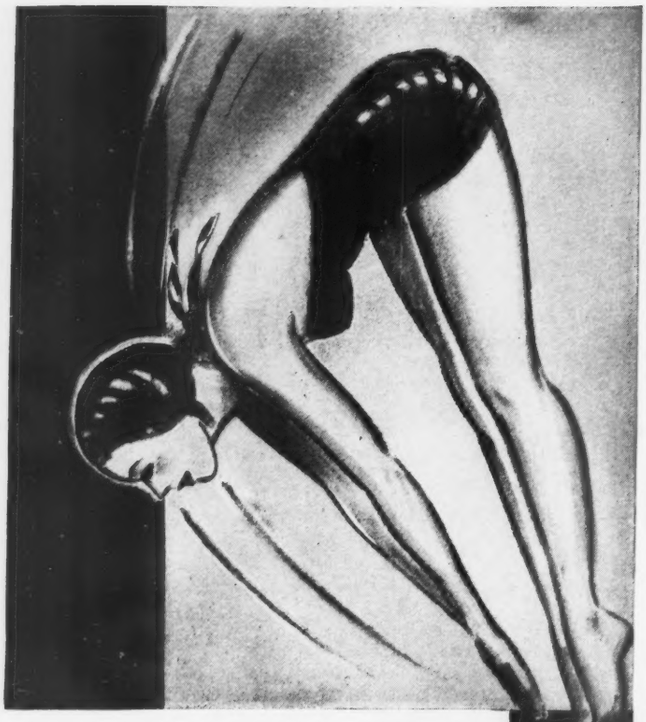

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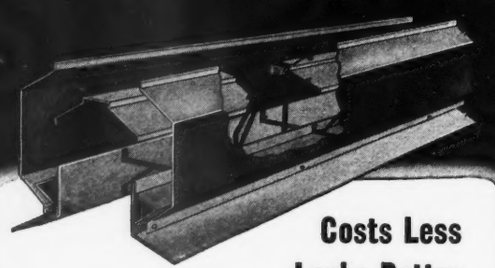

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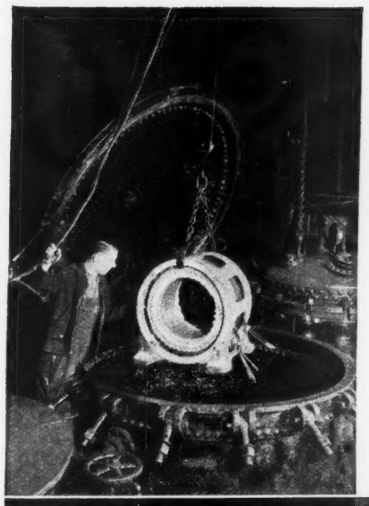

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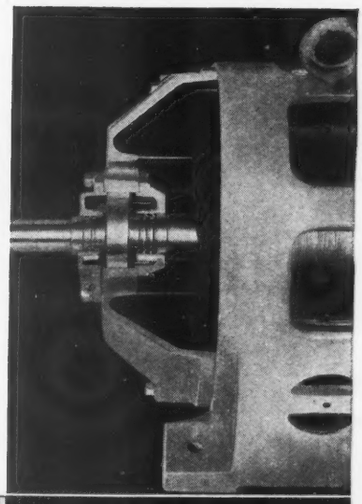
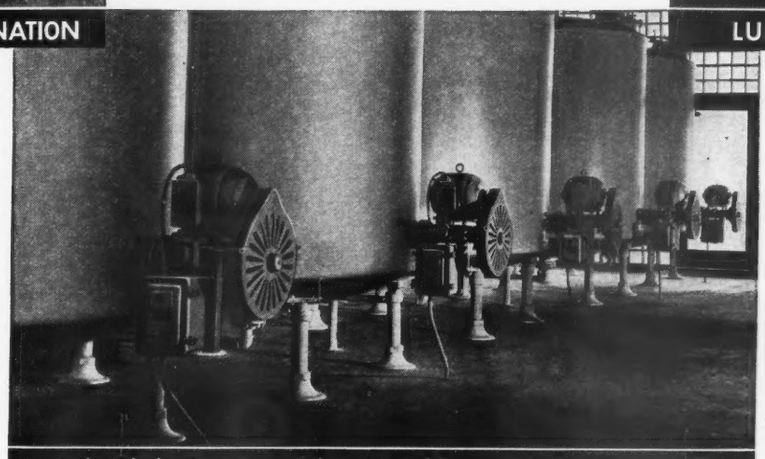


LUBRICANT SEAL



Crocker-Wheeler Motors in new Toiletries Plant of Campana Sales Co., near Batavia, Ill.

TYPICAL of Crocker-Wheeler pioneering and engineering are two construction features found in no other line of general purpose motors.

Vacuum Impregnation is commonly used in the construction of transformers, underground cables and other electrical apparatus, where it is vital to effect complete protection from dirt, oil and moisture. Crocker-Wheeler uses this process in the building of general purpose motors because it is the only process which eliminates the personal element in workmanship and offers complete assurance that all parts of the windings will be thoroughly insulated.

The patented frictionless *Lubricant Seal* for ball bearing motors prevents dust or other foreign matter from entering, and grease from leaking out of, the bearing housing. Many Crocker-Wheeler motors have run 5, 7 and even 10 years without the grease being changed.

WRITE FOR LITERATURE

Crocker-Wheeler makes a full range of squirrel cage and slip-ring motors. We would like to send you Bulletin No. 250 which describes in detail all the important construction features of Crocker-Wheeler A. C., Polyphase, Induction Motors. Please write on your business or professional letterhead for this Bulletin.

Write for illustrated data folders on any of the lines listed below

CROCKER-WHEELER

POLYSPEED MOTORS
1 TO 7½ HP.

DIRECT CURRENT MOTORS
½ TO 5,000 HP

POLYPHASE INDUCTION MOTORS
¼ TO 10,000 HP.

SYNCHRONOUS MOTORS
15 TO 10,000 HP.

CROCKER-WHEELER
TRADE MARK REG U.S. PAT. OFF.

DIRECT CURRENT GENERATORS
UP TO 7,500 KW.

ALTERNATING CURRENT GENERATORS
UP TO 10,000 K.V.A.

MOTOR-GENERATOR SETS
UP TO 7,500 KW.

FLEXIBLE COUPLINGS
UP TO 200 HP.

50 YEARS OF PIONEERING

CROCKER-WHEELER ELECTRIC MFG. COMPANY, AMPERE, NEW JERSEY

Neoprene conveyor belt in severe service CUTS UPKEEP COSTS

A PROBLEM: Conveyor belt trouble arose when a certain large power plant switched to oil-treated coal. The oil on the coal softened the belting then in use so that it wouldn't track. The belt slipped, stretched, abraded, and finally gave out entirely after only five month's service.

THE SOLUTION: A belting manufacturer recommended a belt made of Du Pont *neoprene*. So a belt with a specially-compounded neoprene cover was installed, and trouble was over. Even after a year's service, the neoprene belt didn't soften, slip, stretch, swell, or abrade to any appreciable degree. The belt is still in excellent condition.

THE MATERIAL: Neoprene is Du Pont's remarkable chloroprene rubber. Compounds made of it have the strength, resiliency and toughness of natural rubber—yet they are far more resistant to oils, gasoline, sunlight, aging and corrosive acids and gases.

A SUGGESTION: Wherever conveyor belts operate under severe service conditions, ask your belting supplier for Du Pont neoprene. The reliability and money-saving features of neoprene belting have been proved many times.

DU PONT REG. U.S. PAT. OFF. **NEOPRENE**

E. I. DU PONT DE NEMOURS & CO., INC.
RUBBER CHEMICALS DIVISION, WILMINGTON, DELAWARE

INDUSTRIAL CONSULTANTS

OLIVER FIELD ALLEN
Licensed Professional Engineer, New York State
Fellow: A.I.E.E. Member: A.S.M.E. S.A.E.
Am. Chem. Soc., Soc. Am. Mil. Engrs.
Consulting Engineer
Diesel Engines, International Engineering Liaison,
Gas and Oil Engine Power Applications.
Regular Foreign Correspondents
117 Liberty Street, New York City
Cable Address: OFALL-New York

METHODS ENGINEERING COUNCIL
MOTION AND TIME STUDY INDUSTRIAL MANAGEMENT
INSTRUCTION CONSULTATIONS
TRAINING INSTALLATIONS
Wood and Franklin Streets, Station 21
Pittsburgh, Pa.

ALLAN H. MOGENSEN
Training in Work Simplification
330 W. 42nd Street
NEW YORK CITY

INEFFICIENCY

with its resultant waste, plays havoc with production costs.

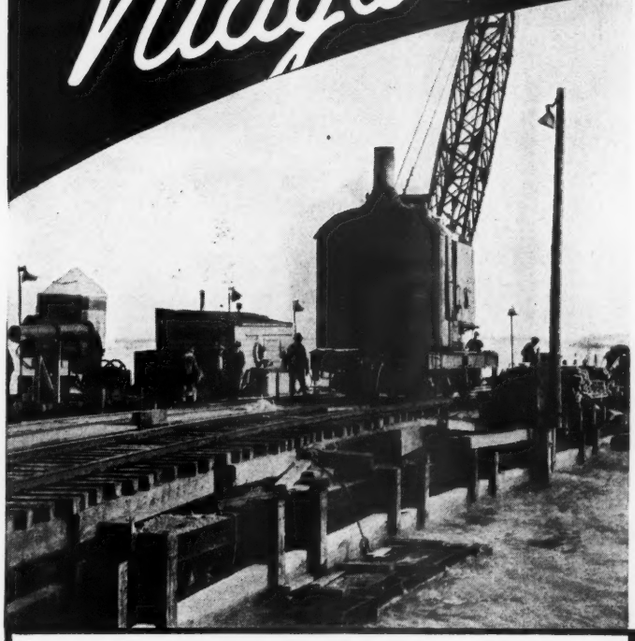
PROFITABLE OPERATION

is dependent upon correct plant design, management, processes, equipment and methods.

ADVICE

available through a CONSULTING ENGINEER is frequently the only necessary means of putting a plant on a more efficient production basis.

Niagara GETS A "FACIAL"



The operating pier, shown above, was constructed of fifty-one structural steel cells, each measuring 12 x 24 ft. and having a capacity of 50 cu. yds. of gravel ballast. The Industrial Brownhoist steam locomotive crane was used to place these cells in position, as well as assisting with other heavy, handling work.

One of the interesting projects on which an Industrial Brownhoist has served was the recent construction of a submerged dam at Niagara Falls. Extending 930 feet from the Canadian shore obliquely upstream, this dam will serve a two-fold purpose — to restore the water level in the forebay of the Canadian power plant, and to preserve the beauty of the Falls.

Materials, as they come in and pass through your plant, are like the waters of Niagara. Uncontrolled they quickly wash away profits — properly handled they provide the steady, even flow to production which insures greater efficiency and lower costs.

Have you checked recently to see how much a new Industrial Brownhoist will save on your handling work? Whether your tonnage is huge or small, the figures may surprise you as they have most people who have asked us to help compile them.

INDUSTRIAL BROWNHOIST

GENERAL OFFICES: BAY CITY, MICHIGAN

DISTRICT OFFICES

New York, Philadelphia, Pittsburgh, Cleveland, Chicago,

WHERE TO BUY

SUPPLEMENT

Featuring additional products and specialties for manufacturing plants

TRICO

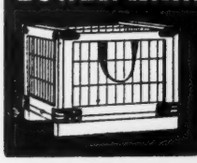
KLIPLOK CLAMPS

FOR FUSE CLIPS

Lock fuses and clips together. Eliminate burnt fuses, premature blowings, wasted power.

WRITE FOR LITERATURE

TRICO FUSE MFG. CO. — Milwaukee, Wisconsin



LOWER HANDLING COSTS!

LEWIS CONTAINERS

Skid Boxes - Box Trucks

Shipping Boxes - Trays

G. B. LEWIS CO.

Dept. X1 Watertown, Wis.

TRICO

POWDER-PACKED FUSES ARE DIFFERENT!

That famous "powder packed" element adds so much in safety, efficiency, time-lag, dependability—at NO EXTRA COST

TRY TRICO TODAY

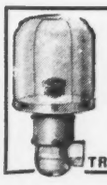
TRICO FUSE MFG. CO. MILWAUKEE, WIS.

COIL-SPRING Stopwatches

All Minerva Stopwatches have patented *coil* springs and perfect "fly-back to zero," guaranteed for life. FREE TRIAL. (Repair service, all makes.) *Write for catalog.*

M. DUCOMMUN CO.

580 Fifth Ave. New York



Unbreakable

New OILERS

Modern! Streamlined!

For maintaining a constant level of oil in ring or ball bearings, pump and gear housings, etc.

Write for Bulletin No. 25

TRICO FUSE MFG. CO., Milwaukee, Wis.

THE PURE

PURE THREE POINT LUBRICATION

A Complete Line of Industrial Petroleum Lubricants

Ask a Pure Oil Engineer to help solve your lubrication problems

OIL CO.

CHICAGO U.S.A.

FAN *interest into* BUYING ACTION

You can fan interest into orders with Performance Photos that show your product in actual operation. They will add power to all your advertising and selling efforts, and will help boost your sales skyward. Costing little . . . they greatly reduce selling cost. Send for illustrated booklet.

Photographic & Illustration Department
McGraw-Hill Publishing Co., Inc.
330 West 42nd Street
New York City

SEARCHLIGHT SECTION

EMPLOYMENT : BUSINESS : OPPORTUNITIES : EQUIPMENT—USED or RESALE

UNDISPLAYED RATE:

15 cents a word, minimum $3.00 an insertion.

(See ¶ on Box Numbers)

Positions wanted **(full or part-time salaried employment only), ½ the above rates.**

Proposals, **40 cents a line an insertion.**

INFORMATION:

Box Numbers **in care of our New York, Chicago or San Francisco offices count 10 words additional in undisplayed ads.**

Discount of 10% **if full payment is made in advance for four consecutive insertions of undisplayed ads (not including proposals).**

DISPLAYED—RATE PER INCH:

The advertising rate is $8.00 per inch for all advertising appearing on other than a contract basis. Contract rates quoted on request.

An advertising inch **is measured ⅞ inch vertically on one column. 3 columns—30 inches—to a page.** **F.M.M.**

Copy for new advertisements must be received by August 21st for the September issue

—TRANSFORMERS—

A Complete Stock **Prompt Shipment**

6—500 KVA Pittsburgh Transformers 25200/23800/22600–2300/4000Y volts ..... **$1025.00** Each

We Rewind, Repair and Redesign all Makes and Sizes

ALL TRANSFORMERS GUARANTEED FOR ONE YEAR

Write for Catalog No. 134D

THE ELECTRIC SERVICE CO., INC.

"AMERICA'S USED TRANSFORMER CLEARING HOUSE"

STATION M **Since 1912** **CINCINNATI, OHIO**

RE-NU-BILT MOTORS GENERATORS TRANSFORMERS LARGE & HEAVY ELECTRIC POWER EQUIPMENT

Thoroughly Tested Before Shipment *And* Guaranteed

RE-NU-BILT BELYEA MOTORS

MORE THAN 50% SAVING

BELYEA CO. INC.

35 HOWELL STREET

JERSEY CITY, NEW JERSEY

POSITION VACANT

(See also "Selling Opportunity Offered")

ENGINEERS, DESIGNERS and DRAFTSMEN —Send for application. No advance fee. Immediate openings for experienced men on machinery, electric motors, tools, appliances, product design, special machinery, structural steel, tanks, engines, tractors, aircraft, excavating machinery, etc. No limit to territory. Harrison Personnel Service, 20 W. Jackson Blvd., Chicago. Established 24 years.

EMPLOYMENT SERVICE

EXECUTIVES AND TECHNICAL MEN. Contact employees for positions through our confidential and effective methods. We negotiate preliminary overtures. Established 24 years. Inquiries invited. H. H. Harrison, Director. The National Business Bourse, 20 West Jackson Blvd., Chicago.

POSITIONS WANTED

YOUNG ENGINEERING GRADUATE June 1939, Industrial Major. Desires position of any kind. Willing to accept small salary in exchange for experience. Location open. PW-575, Factory Management and Maintenance, 330 W. 42nd St., New York, N. Y.

PLANT ENGINEER 39, have been in complete charge of maintenance, construction, plant layout and design, power plant, tool room, budgeting, taxation and personnel work. 18 years experience. Salary open. Go anywhere. PW-538, Factory Management & Maintenance, 520 N. Michigan Ave., Chicago, Ill.

MR. PRESIDENT. Are you satisfied with the profits on your manufacturing business? You can secure the services of a high grade executive with 25 years experience with nationally known concerns in all phases of development and manufacture of mechanical products of outstanding quality. PW-561, Factory Management & Maintenance, 330 W. 42nd St., New York, N. Y.

CHIEF INDUSTRIAL ENGINEER—Sixteen years broad experience all phases of industrial engineering, hardware, process, non-rigid manufacturing and educational background. Capable manager. Excellent labor relations. Available as Chief Industrial Engineer, Ass't. Works Manager, Director of Training, age 41. Protestant. Married. Employed. Investigation invited. PW-581, Factory Management and Maintenance, 330 W. 42nd St., New York. N.Y.

MAINTENANCE ENGINEER, 33, E.E. degree, desires change, 10 years experience, solving electrical, mechanical, steam, safety, layout problems in medium sized plant. PW-580, Factory Management & Maintenance, 330 W. 42nd St., New York, N. Y.

FACTORY SUPERINTENDENT, 20 years experience executive capacity in metal industry, familiar with all phases of modern factory management, desires permanent position with growing concern. Very successful in cost reduction and handling of help. PW-579, Factory Management & Maintenance, 520 N. Michigan Ave., Chicago, Ill.

POSITIONS WANTED

PROGRESSIVE SUPERINTENDENT available, age 44, excellent record of accomplishments. Thorough basic training as Machinist, Tool Designer, Foreman and Time Study Engineer in the Machine shops of three of the Country's largest Companies, and a large sheet metal fabricating plant. Address George C. Hart, 508 N. Bouldin St., Baltimore, Md.

MAINTENANCE MAN: ASSISTANT ENGINEER: or any offer. 38. 3½ years technical training. Expert pipe-fitter, high-low pressures; steam, oil, power plant; refrigeration, air-conditioning, etc. Some industrial instrumentation repair. Genuine interest and complete knowledge industrial plant fire prevention, and safety assurance. Locate anywhere. PW-582, Factory Management and Maintenance, 330 W. 42nd St., New York, N. Y.

SELLING OPPORTUNITIES

OFFERED—WANTED

Selling Agencies—Sales Executives
Salesmen—Additional Lines

OPPORTUNITY OFFERED

PRODUCTION & COST EXECUTIVES—District Manager with diversified experience production methods; qualified to interest factory executives in McCaskey Industrial Control systems for production scheduling, follow-up and costs, inventory, tool service, etc. and lay-out proposals for varying production requirements; must own car; drawing account against commissions; thorough training McCaskey methods; write full details education and experience D. Cameron, McCaskey Register Co., Alliance, Ohio.

SALARIED POSITIONS

$2,500 to $25,000

This thoroughly organized advertising service of 29 years' recognized standing and reputation carries on preliminary negotiations for positions of the caliber indicated above, through a proceduce individualized to each client's personal requirements. Several weeks are required to negotiate and each individual must finance the moderate cost of his own campaign. Retaining fee protected by a refund provision as stipulated in our agreement. Identity is covered and, if employed, present position protected. If your salary has been $2,500 or more, send only name and address for details.

R. W. BIXBY, INC.

276 Delward Bldg., Buffalo, N. Y.

ELECTRICAL MACHINERY

Motors and Generators, A.C. and D.C. for sale at Attractive Prices. Large stock. New and Rebuilt. All Guaranteed. *Write for Stock List and Prices.*

V. M. NUSSBAUM & CO.

FORT WAYNE, IND.

WANTED

15 KVA, AC Alternator 220-440 V, 60 Cy, 3 phase, any condition.

FOR SALE

2—American Blower exhaust fans 26", 2 phase, 220-440 V, G.E. Motor, new condition. $45 ea.

Crahall Electric Repair Service

Wilkes Barre, Pa.

In New Jersey

It's Schlesinger for Factories

Suburban town—11 miles to New York City on main line—75,000 square feet—modern brick two story, sprinklered building—concrete and wood floor—railroad siding—labor, skilled and unskilled, available and co-operative. Ideal for all types of manufacturing desiring clean airy space. Sales Price $55,000. Lease 15c per square foot.

LOUIS SCHLESINGER, INC.

31 Clinton St. **Newark, N. J.**

Market 2-6500

MODERN PRODUCTION METHODS

require capable men trained in cost reduction and methods improvement techniques. Industry is demanding trained Methods Engineers who are specialists in work simplification and motion and time study procedures to reduce costs and increase productivity and quality. Fitting men for such responsible positions in industry is accomplished by popular home training courses in Methods Engineering compiled and offered by the staff engineers of the

METHODS ENGINEERING COUNCIL

Industrial Training Division

Wood and Franklin Streets

PITTSBURGH, (21), PENNSYLVANIA

Send now for free booklet describing in detail all our popular home training courses.

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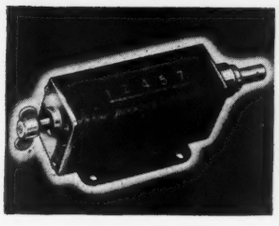
When You See This Card

. . . *see the man who sends it in*

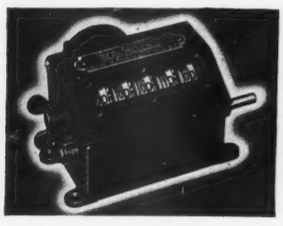
Your Veeder-Root representative is a good man to know . . . generally has something of definite interest *to your interests.* He has a complete working knowledge of the world's most complete line of counting and computing devices . . . and knows how to apply it. He may be able to show you an unsuspected chance to profitably apply these devices to your production and office equipment . . . *or to your product, to increase its utility and saleability.* His trained eye can see profit-possibilities not apparent to you.

And when there's important news in counter and computer developments, your Veeder-Root representative always has it . . . *first.* For he is backed by the recognized engineering leadership in this field . . . by a worldwide organization with more than 60 years practical, specialized experience. So it's always worth your time to see what he has to offer. *See him when he calls.*

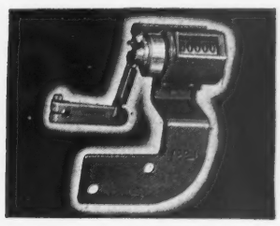
IDEA-FOLDER Monthly to You: May we send you a file-size monthly folder, describing interesting uses of Veeder-Root Devices? *Just send us your name on your company letterhead.*



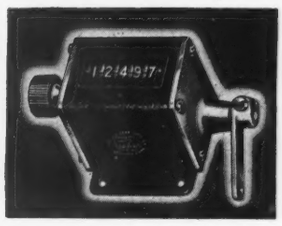
FOR HIGH SPEED WORK *This High Speed Resetting Counter operates at 8,000 counts per minute in direct-drive type . . . 2,000 in revolution type.*



CONTROLS MACHINE RUNS *This Predetermining Counter prevents over-runs and shortages on winders, fast automatics, etc., running at speeds up to 2500 R. P. M.*



FOR OFFICE AND LIGHT PRODUCTION MACHINES *Small Reset Counters count strokes or revolutions. May be furnished with totalizing register.*



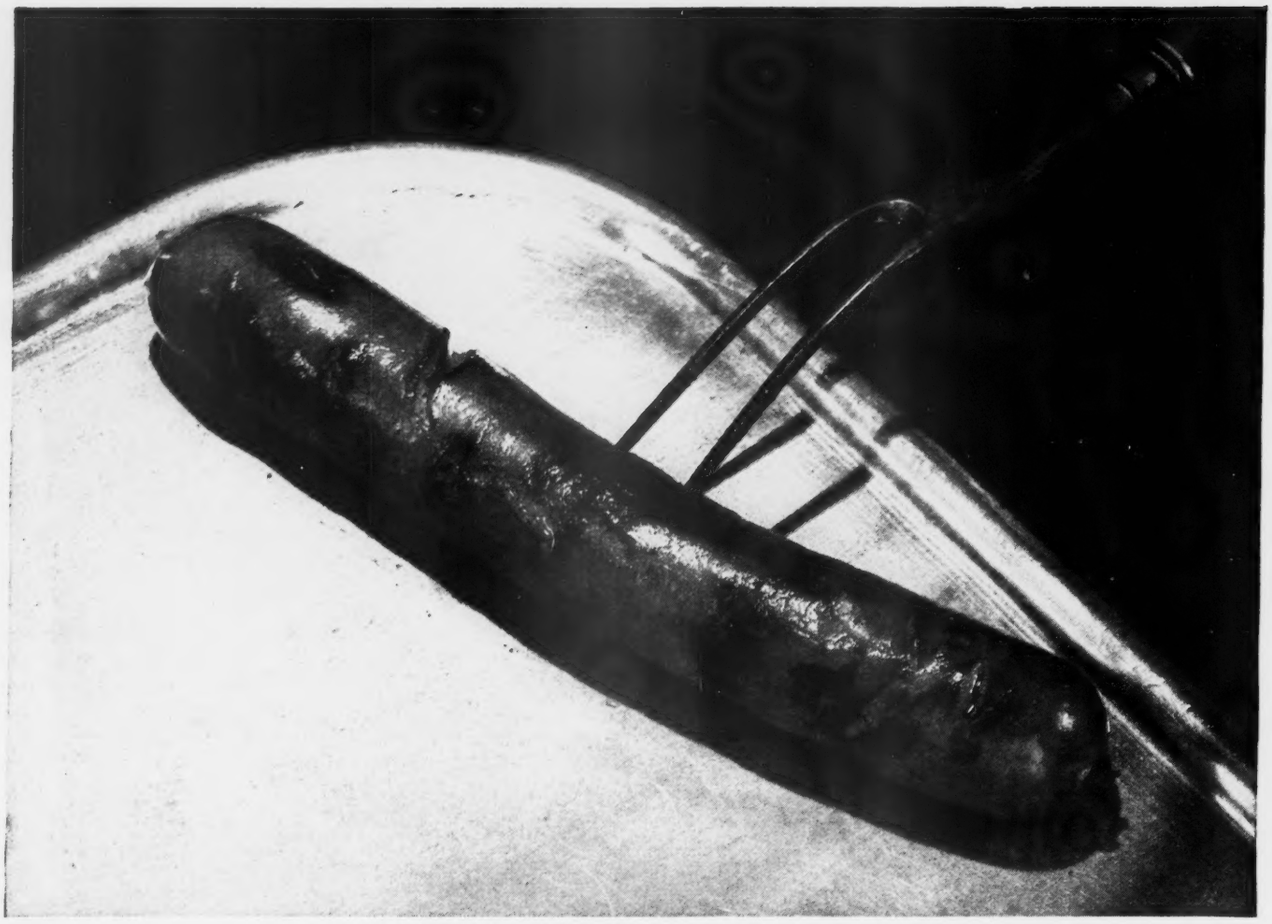
ACCOUNTING & TYPING *This Production Computator records each keystroke on typewriters and accounting machines. Provides basis of wage-payment.*

OFFICES IN Boston, Chicago, Cincinnati, Cleveland Detroit, Greenville, S. C., Los Angeles, New York, Philadelphia, Pittsburgh, St. Louis, San Francisco, Montreal, Buenos Aires, Mexico City, London, Paris, Tokio, Shanghai, Melbourne.

Veeder-Root Inc.

HARTFORD, CONNECTICUT

WORLD'S LARGEST MANUFACTURERS OF COUNTING AND COMPUTING DEVICES



Beware of "HOT DOG" INSULATION

When the skin cracks open it's high time to turn off the heat. Mr. Hot Dog is done! Cracks in the insulation of your control, lighting or power wiring show that heat has been at work, too, and as in the case of the hot dog, the cracks indicate that the wire is definitely "all done."

But just because you have heat-exposed installations don't get the idea that you have to put up with frequent breakdowns and expensive replacement. Rockbestos is built to stand up in just such tough locations. It takes the heat without flowing, drying out or cracking, and you can run it in high temperature areas or as close to boilers, furnaces, steam lines or other heat-producers as necessity demands. It is also fireproof and practically immune to rotting, blooming and swelling so often caused by oil, grease and corrosive fumes because of the indestructible character of its insulation. Try it the next time one of your heat-dried circuits calls out the trouble crew.

We manufacture wires, cables and cords for severe conditions exclusively. Constructions range from fine magnet wire to 2,500,000 C.M. cable for service voltages up to 8000. All of them bring you the "Ten Tested Rockbestos Values." Write for a catalog and ask for samples. Rockbestos Products Corporation, 929 Nicoll St., New Haven, Conn.

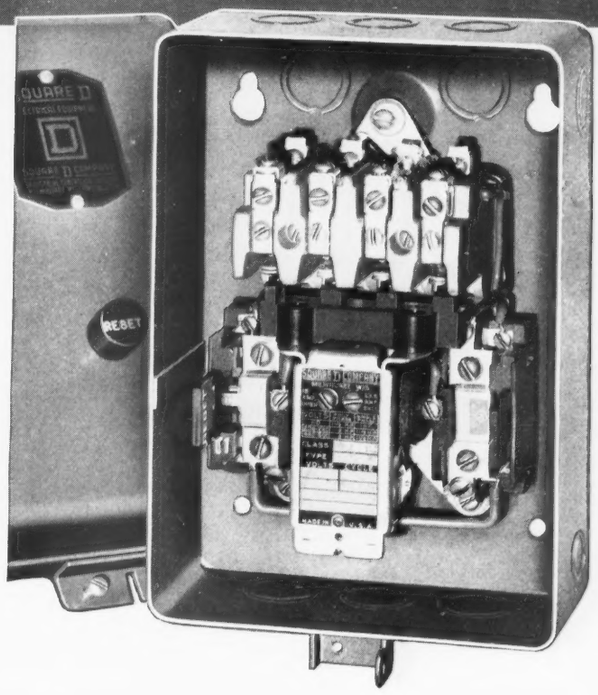
TEN TESTED ROCKBESTOS VALUES

1. Heatproof
2. Fireproof
3. Permanent
4. Lower maintenance cost
5. Resists heat and vibration
6. Saves work
7. Oil and Greaseproof
8. High overload capacity
9. Permanently flexible
10. Greater carrying capacity

Also refer to Electrical World Buyer's Reference

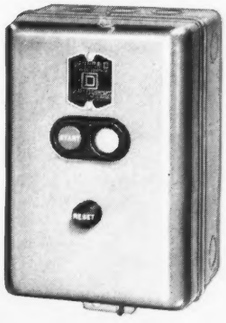
Announces

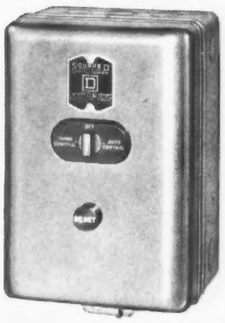
A SMALLER AUTOMATIC STARTER FOR ALTERNATING CURRENT MOTORS



● The new Size O, Type R, is a smaller vertically operating starter in the Class 8536 line. It meets the demand for an automatic starter for the smaller sizes of polyphase and single phase motors. Maximum polyphase ratings are 2 H.P., 220, 440, 550 Volts; maximum single phase ratings are 1 H.P., 110 Volts or 1½ H.P., 220 Volts.

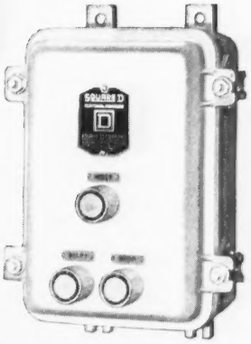
This starter has a vertically operating magnet, double break silver contacts and thermal overload relays. It is offered with general purpose, dust-tight, water-tight or Class II, Group G enclosures; also as a combination starter with either disconnect switch or circuit breaker; also in the reversing type.



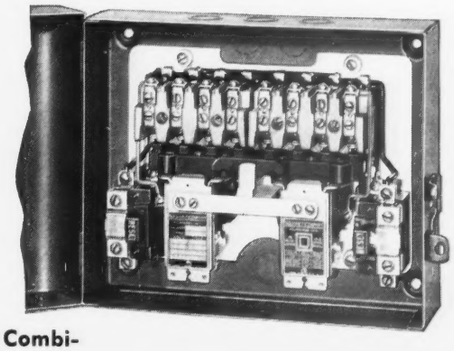


(*Extreme Left*) Start-Stop push buttons in cover

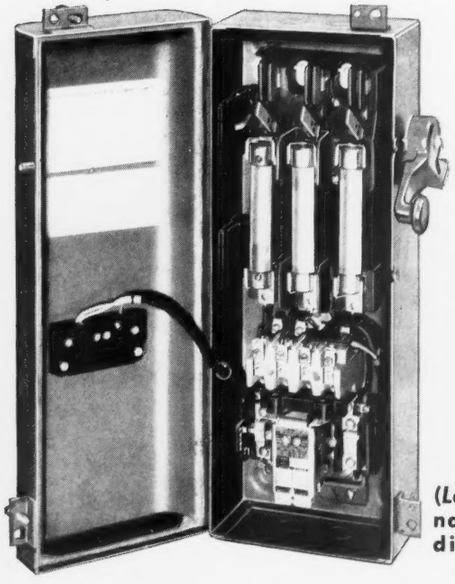
(*Left*) Three-Way selector switch in cover



(*Above*) Water-tight, dust-tight or Class II, Group G enclosure



(*Left*) Reversing automatic starter



(*Left*) Combination with disconnect switch

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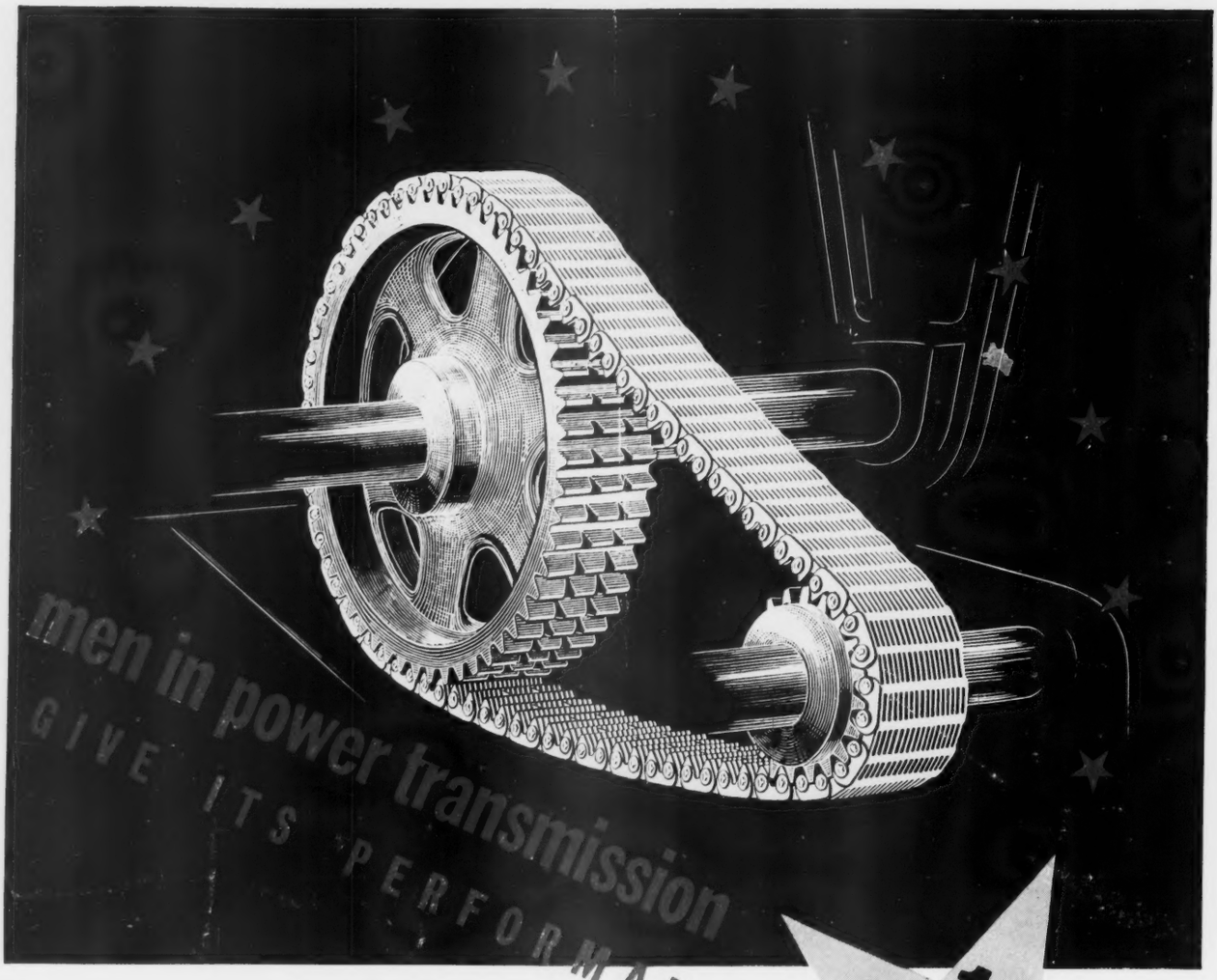

HERE IS THE BASIC PRINCIPLE OF MORSE CHAIN DRIVES:

It is difficult to get a good grip on a smooth faced wheel. It is even difficult to get a good grip on a grooved wheel. But—it is easy to grip and turn a toothed sprocket. Teeth, not tension, do the trick. The teeth in Morse Chains, too, grip and hold and cannot slip.

11 STARS

- ★ LONG LIFE
- ★ COMPACTNESS
- ★ RUGGEDNESS
- ★ FLEXIBILITY
- ★ NO SLIPPING—"TEETH, NOT TENSION"
- ★ CAPACITY TO TAKE SEVERE OVERLOADS
- ★ HIGH EFFICIENCIES—UP TO 99.4% THROUGH WHOLE LIFE OF DRIVE
- ★ SAFETY PROTECTIVE HOUSINGS
- ★ MINIMUM MAINTENANCE
- ★ LOW FIRST COST
- ★ ADAPTABILITY

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